THE DIFFERENCE IN COVID- 19 INFECTION RATES: AN EXAMINATION OF RESIDENTIAL CARE COMMUNITIES (RCCS)

by

Han Yang

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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Abstract

Infection control practices (ICPs) are crucial for maintaining the health and safety of residents in a residential care community (RCC). This paper examines the differences in COVID-19 infection rates and cases based on the characteristics of RCCs, such as ICPs, personal protective equipment (PPE) shortages, ownership type (for-profit vs. nonprofit), census regions, and RCC size. While ICPs contribute significantly to preventing and controlling the highly contagious virus, a comprehensive program is encouraged to provide a targeted intervention based on RCC's environmental factors. The importance of the characteristics of the RCCs must be considered in combing with the ICPs to enhance the impact of the infection practices, which will substantially improve the overall success of the infection control and prevention in COVID-19 outcomes. Systems Theory offers the lens for researchers to evaluate, examine, and compare various factors that are associated with the outcome of disease transmission and how those factors are related in certain settings. It facilitates the components such as census region, PPEs, size of the facility, and ownership type (for-profit vs. nonprofit) that are closely linked and provides feedback in a more accurate way to improve the overall success of the process. The study employed ANOVA to test the mean difference between each characteristic, revealing that for-profit and larger organizations tend to have higher infection rates in terms of the ICPs outcomes. However, there were contradictory results concerning other variables for PPE shortages and geographical variations ($p>0.05$), calling for more diverse explorations regarding the prevalence of ICPs and characteristics of RCCs in the future research.

Keywords: COVID-19, residential care communities (RCCs), infection control practices (ICPs), older adults

Dedication

I would like to dedicate this dissertation to my beloved parents, whose endless encouragement and sacrifice have shaped me into the person I am today. Your inspiration has led me to pursue my passion in this field and more in my life.

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I would like to take this opportunity to acknowledge individuals who have contributed to my success of this dissertation journey. First, I want to express my gratitude to my committee chair, Dr. Cynthia Williams. Thank you for believing in me and guiding me throughout the research process. Your expertise, encouragement, and dedication have been instrumental in supporting my study and helping me navigate the challenges along the way. I also want to thank the other committee members, Dr. Kala Dixon and Dr. Keith Pellitier, for their insightful comments, and constructive input.

Secondly, I would like to acknowledge the unwavering support of my family members, whose love, encouragement, and understanding sustained me throughout this journey. Their beliefs in my ability and persistence have constantly inspired me to strive for excellence through challenges. Additionally, I wish to express my appreciation to my friends and colleagues who offered words of encouragement and support.

Finally, I would like to acknowledge the guidance and inspiration I have drawn from a biblical perspective throughout the journey. The wisdom and principles found in Scripture have served as a source of strength, determination, and guidance in the journey of doctorate program.

Table of Contents

CHAPTER 1: INTRODUCTION

Overview

Infection control practices (ICPs) encompass variety of measures to prevent the transmission of infectious diseases, which are crucial for safeguarding the safety and well-being of residents and staff at long-term care facilities, including residential care communities (RCCs) (Rowe et al., 2020; Iyamu et al., 2022). These facilities serving a diverse range of individual, particularly older adults and those with chronic health conditions, who are highly vulnerable to infectious disease. Although numerous recommendations have established by health authorities such as the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) to mitigate the transmission of the virus, there remains to be a notable variation in the adherence and quality of infection control measures within residential care communities. Factors contributing to the variability include resource constrains, inadequate staff training, and lacking the understanding of the characteristics of facilities (McGregor & Harrinton, 2020; Bouabida et al., 2022). Therefore, it is imperative to investigate the infection control measures within RCCs and discern the factors that contributed to the outcome of infection control practices.

The Coronavirus Disease 2019 (COVID-19) pandemic has significantly impacted the global health, causing a substantial health recession (Banks et al., 2020). In response to the highly contagious nature of the COVID-19 virus, healthcare institutions had to take steps to control and prevent the spread of the virus (Kusumasari et al., 2022; Tang & Wang, 2020; Smith et al., 2019). The COVID-19 virus can severely weaken individuals' immune systems and potentially cause death. A more recent study indicated that more than 90% of the infected cases in US were contributed by Delta variant comparing to Alpha, Beta, Gamma and Eta linage (Zhao et al., 2022). Alpha variant was identified to spread much faster comparing to other variants, while Beta was more common in Brazil and South Africa (Zhao et al., 2022). Therefore, preventive measures and infection control strategies, including preparing and distributing materials, training on infection prevention measures, using of telemedicine, and keeping environment clean were essential to maintaining the public's health security (Bouabida et al., 2022; Lu et al., 2020). However, there are constraints associated with infection control practices, such as resources limitations in terms of PPEs and equipment, and availability of trained healthcare workers in public hospital compared to private ones (Sodhi et al., 2023). Thus, infection control and prevention strategies must be developed to meet the unique needs of each individual facility to promote the overall success of infection control outcomes.

This dissertation investigates the differences in infection control outcomes by comparing the practices and their influential factors in residential care communities. By examining Systems Theory and infection control methods, this research seeks to provide valuable insights that can inform future interventions and policy changes to enhance the health and safety of residents in these care settings.

The significance of this research lies in its potential to improve the outcome of infection control practices by identifying the effective strategies and factors for infection prevention and control in RCCs. Infection control and prevention strategies include proactive approaches and methods to mitigate the spread of virus, such as clear communications, screening and triage procedures, and risk assessment to ensure the safety in isolated facilities (Sims et al., 2022; Chan et al., 2021). The findings of this dissertation will contribute to be existing literature on infection control practices and provide practical guidance for healthcare professionals, policy makers and organizational leaders seeking to implement effective infection control measures. Ultimately, this research has the potential to enhance the health and well-being of residents in RCCs and improve the overall quality of care.

Background

Residential care communities are essential in delivering crucial support services including assistance with activities of daily living (ADLs) to specific populations, such as older adults and those with age related medical frailties. However, the vulnerability of residents in RCCs elevates the risks of infectious disease transmission. The fatality of COVID-19 among the older adult patients can be linked to various factors, including their comorbid conditions and aged immune system (Benksim et al., 2020). As of November 5th, 2023, there were total of 1,808,640 confirmed COVID-19 cases among residents and total of 1,752,014 confirmed COVID-19 cases among staff within long-term care facilities (CMS, 2023). According to a Mueller et al. (2020) study, individuals aged 65 and above constituted 80% of the hospitalizations caused by COVID-19 and faced a 23-fold higher risk of death compared to those below the age of 65. Thus, implementing infection control practices is essential to safeguard the well-being of both residents and health care workers engaged in the residential care communities (Yombi et al., 2020). Early studies indicated that between 40% to 45% of COVID-19 related deaths have occurred in long-term care settings, emphasizing the importance of ICPs (Smith et al., 2019; Baker et al., 2020).

With the ongoing COVID-19 pandemic, there was a concern related to the consistency of ICPs adoptions in the public (Chow & Guo, 2023). For instance, physical distancing interventions were not uniformly implemented across the United States due to the different regulations established by the states and local authorities (Althouse et al., 2020). Other inconsistencies associated with telehealth utilizations and PPE shortages may result from several factors, including resources constraints and insufficient staff training (McGregor & Harrinton, 2020; Bouabida et al., 2022).

Problem Statement

During the pandemic, the inconsistency of ICPs adoptions has led to disparities in infection prevention outcomes (Chow & Guo, 2023). Factors contributing to these disparities include resources constraints, inadequate staff training, and lack of understanding about facility characteristics (Harrington et al., 2020; Bouabida et al., 2022). Inadequate staff training can lead to lack of knowledge and awareness of implementing the proper ICPs, while insufficient resources and lack of understanding about facility characteristics can create challenges in practicing and maintaining uniformed infection control measures (Harrington et al., 2020; Bouabida et al., 2022). As a result, residents are at an increased risk of acquiring infections, leading to complications, prolonged hospitalizations, and even death.

Previous studies have underscored the importance of ICPs and outcomes linked to public intervention, the author contends that there is still a gap or need for emphasizing the potential impacts of environmental factors on the outcome of infection control practices (Smith et al., 2019; Lu et al., 2020; Chin et al., 2020; Ayouni et al., 2021; Yombi et al., 2020). However, little is known about the impact of environmental factors and characteristics in reducing the infection rates of COVID-19 among older adults within RCCs. Despite previous studies have consistently examined the effectiveness of ICPs, such as Ayouni et al. (2021) and Zhang et al. (2020) found that implementing the combination of public health practices (social distancing, hand hygiene, isolation, and lockdown) can effectively reduce the risk of COVID infection by 50% if all symptomatic individuals are immediately isolated and follow with practice public measure afterwards. Yet, there is lack of studies to examine the differences between each measure and its outcome affected by the characteristic of long-term care settings. Examining the differences between ICPs and outcomes, influenced by the characteristics of long-term care settings, is important for understanding the nuanced impact of these measures and tailoring interventions to the unique needs of these settings.

Purpose Statement

The purpose of this study was to assess the differences in COVID-19 infection rates and cases based on the characteristics of RCCs (i.e., ICPs, facility size, census regions, PPE shortages, and ownership type: for-profit vs. nonprofit) using ANOVA and factorial ANOVA. The objectives of this study are to identify the infection control practices used in RCC, assess their efficiency in preventing COVID-19, and investigate variables that can affect the adoption of these procedures. While residential care communities provide essential care to the vulnerable populations, it is crucial to implement effective infection control practices to these communal settings and minimize the risk of infection transmission.

The study employed a quantitative approach to answer the research questions and to understand the outcome and differences of infection control practices based on the characteristic of residential care communities. This study will analyze existing data from the 2020 National Post-acute and Long-term Care Study (NPALS) and National Healthcare Safety Network (NHSN) on infection rates and infection control practices within the residential care community setting. These analyses will help to identify differences between facility characteristics and infection control outcomes.

Significance of the Study

One significant aspect of this study is its focus on the outcome of individual facility infection practices in a multi-faceted approach. The various facets examined in this study are ownership, environmental factors, and availability of the resources in RCCs. Effective infection control depends on sufficient resources (PPE shortage), leadership support (ownership of the facility), and environmental factors (size of the facility and geographical location). By investigating the influence of each feature in the RCC setting, this research can provide insights into how each characteristic can impact the overall implementation of infection control practices in RCCs with different facility sizes and geographical locations. This may include the potential recommendation of policies and procedures that reinforce infection control, as well as the promotion of resource allocations.

The study also emphasizes the availability of appropriate resources as it is pivotal to the effectiveness of infection control practices. Cohen & Rodgers (2020) study indicated that the lack of effective PPE supply chain and distribution had impacted the safety of health care professionals and patients with increased risk of COVID outbreak across the globe. As the study revealed concerning statistics with 87% of nurses reported having to reuse a single disposal mask, and 27% nurses reported exposing to confirmed COVID-19 patients without having appropriate PPE, placing healthcare staff in a heightened risk of infection environment (Cohen & Rodgers, 2020). A more recent study has also reported requesting consumptions of large numbers of healthcare resources for patients with post-acute COVID syndrome and preparation for potential outbreaks (Montani et al., 2022). Through the examination of correlations between resource availability and ICPs, this study is aimed to pinpoint the areas that need to be improved and provide evidence-based strategies to optimize the resources utilizations and ICPs outcomes.

Another significant aspect involves employing ANOVA alongside a theoretical framework to test mean differences in terms of COVID-19 infection outcomes based on the characteristics of the RCCs. This approach allows for a deeper understanding of the complexity of organizational factors that impact infection control practices in residential care communities. By examining these factors, this research can inform the development of targeted interventions and policy changes that address the unique challenges different residential care communities face.

Research Questions

RQ1: Is there a significant difference in the adoption of ICPs in reducing COVID-19 cases in RCCs?

RQ2: Is there a significant difference between for-profit and nonprofit centers' infection control practices, PPE shortages, and COVID-19 cases?

RQ3: Is there a significant difference in infection control practices, PPE shortages, and COVID-19 cases between facilities in different census regions?

RQ4: Is there a significant difference between small, medium, and large-sized facilities' infection control practices, PPE shortages, and COVID-19 cases among patients in residential care communities during COVID-19?

Definitions

The following definitions are presented as they are used throughout the literature review and within discussing the critical components of the study. All referenced definitions are associated with corresponding empirical citations.

1. Infection control Practices (ICPs)- Regulations being implemented in healthcare settings to prevent and stop the transmission of viruses (CDC, 2022). Infection prevention and control (IPC) of COVID-19, when implemented correctly in long-term care settings, can

reduce the risk of COVID-19 mitigation between patients and healthcare practitioners, such as social distancing and symptom screening protocols (Telford et al., 2020).

2. Personal protective equipment (PPE)- PPE serves as a protective equipment to safeguard the healthcare workers by reducing the likelihood of becoming infected and minimizing the exposure to the patients under their care (McCarthy et al., 2020).
3. Ownership type (profit vs. nonprofit) – Types of residential care communities into two major ownership types: profit and nonprofit. The private for-profit category includes publicly traded and limited liabilities facilities. Nonprofit ownership comprises private nonprofit entities, as well as those owned by federal, state, county, and local governments (Caffrey et al., 2015).
4. Residential care communities (RCCs)- RCCs provide licensed assisted daily living services (ADLs) among people who cannot live independently but generally do not require skilled care provided by nursing homes (Caffrey et al., 2022).
5. Telemedicine- Also referred to as telehealth, is the use of electronic information and communications technologies to provide support healthcare when distance separates the providers and patients (Masys, D. R., 1997). The WHO defines telemedicine as the delivery of healthcare services, which enables healthcare providers and patients to exchange valid healthcare information without distance restraints (Dash et al., 2021).

CHAPTER TWO: LITERATURE REVIEW

Overview

Maintaining the health and well-being of residents in RCCs (e.g., nursing homes, assisted living facilities, and other long-term care settings) is vital (Anderson et al., 2020; Morgan et al., 2021). Understanding the characteristics of RCCs (ICPs, PPE shortages, ownership type (for-profit vs. nonprofit), census regions, and RCC size) is essential to prevent the spread of infectious diseases, such as COVID-19, reduce healthcare-associated infections and healthcare costs, and improve residents' overall quality of life (Anderson et al., 2020; Bouabida et al., 2022). By applying the Systems Theory, this study identified the differences in COVID-19 infection rates (fraction of cases that considers the size of the facility) and cases (total number of occurrences) based on the characteristics of RCCs during the pandemic.

The pandemic caused gaps in treatment availability when RCCs were locked down as a mitigation strategy to reduce the spread of the virus. According to the National Center for Health Statistics (NCHS), a total of 143,036 residents were reported to have either presumptive or confirmed COVID-19 cases from January 2020 through mid-July 2021, 33,984 (23.76%) were hospitalized, and 25,000 (17.48%) were reported death within RCCs (NCHS, 2022). However, the disparity had a notable gap on patients within the RCCs. As more healthcare workers were infected with COVID-19 and subsequent mandate for isolation, facilities found it challenging to provide routine care among residents. Additionally, RCC residents faced heightened risk to the virus due to their vulnerability of compromised immune systems and underlying health conditions. The previous study indicated that the case-fatality rates of COVID-19 were as high as 71% among older adult patients who were over 65 years old (Veiga & Cavalcanti, 2023). To address these challenges, this study aims to examine the outcome of implemented ICPs of RCCs preventing the spread of COVID-19 included ICPs, PPE shortages, ownership type (for-profit vs. nonprofit), census regions, and RCC size. The study examined the difference in COVID-19 infection rates and cases based on the characteristics of RCCs.

Theoretical Frameworks

The study will utilize Systems Theory for understanding the differences in COVID-19 infection rates and cases based on the characteristics of RCCs. This framework provides a foundation for identifying the differences in COVID-19 outcomes based on the characteristics of RCCs, which can help researchers and practitioners understand the interplay between individual, organizational, and environmental factors that shape COVID-19 outcomes (Ruis et al., 2016). This framework also aids in identifying the hurdles and facilitators to promote the development of targeted and context-specific interventions based on the unique needs and challenges of RCCs.

Systems Theory

The conceptual framework of Systems Theory emphasizes the importance of considering holistic aspects of the RCC, including ICPs, PPE shortages, ownership type (for-profit vs. nonprofit), census regions, and RCC size (Lee et al., 2019). Census region, PPEs, size of the facility, and ownership type (for-profit vs. nonprofit) display an example of *input* in this study. An ICP (*process*) is directly associated with the input. Nurses and other healthcare practitioners can better monitor, access, or treat patients who had presumptive positive or confirmed COVID-19 infection cases (*output*) through ICPs. The input comprises four major components in this study, which are characteristics of the RCCs (Census region, PPE shortage, size of the facility, and profit/nonprofit status). Each input will be examined separately with the adoption of ICPs to evaluate its impact on the outcome of COVID-19 cases. When examining the census region, this study seeks to understand the influence of geographical location and its bounded environmental factor to see if the location will affect the infection outcomes when the same ICPs are implemented within RCCs. Similarly, PPE shortage will be examined to evaluate if resource allocation has an impact on variations in infection outcomes when the same ICPs are adopted. The size of the facility involves space and population density within the RCC, influencing the working and living environment of the residents and healthcare staff. Profit/nonprofit status is important in determining how a facility operates, and shaping its financial structure. This input will also be assessed to evaluate the differences of infection outcomes when same ICPs are implemented.

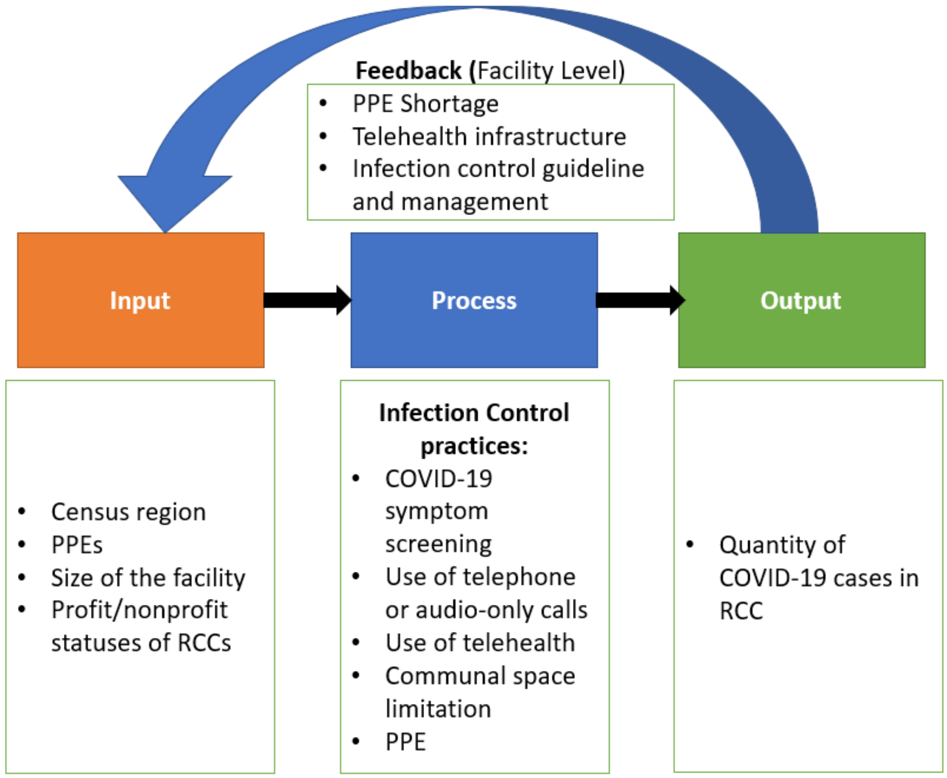

Figure 1.1: Systems Theory

Illustration depicting the foundational concepts of Systems Theory, emphasizing the interconnected components within the RCCs. The figure highlights the interplay between characteristics of the RCCs and adoption of ICPs at a facility level.

Recognizing the interplay between major components of the characteristics of RCCs is imperative for the development of tailored interventions. Systems Theory facilitates the components such as census region, PPEs, size of the facility, and ownership type (for-profit vs. nonprofit) are closely linked and provides feedback in a more accurate way to improve the overall success of the process. The system-oriented perspective can enable the researcher to capture the richer picture and depiction of real-world application and provide opportunities for more comprehensive feedback based on the output (Jason & Bobak, 2022). Considering RCCs as a system can further reinforce the dynamic equilibrium for the facilities. For instance, it can minimize the negative shock brought by COVID-19 and recover the damage of healthcare system as quickly as possible when deficiencies and disruption of the process are accurately and immediately identified.

Utilizing Systems Theory to comprehend the variation existed in COVID-19 infection cases and rates within RCCs entails a rigorous approach that considers the interplay of various factors, such as ownership of the facility (profit vs. nonprofit), facility size, PPE shortage, and census region of the facilities. By mapping out these major components of the RCCs, researchers can facilitate the identification of hurdles and areas for enhancement of the infection control practices. This concept can also foster adaptability and embraces continuous learning and improvement with the analysis of feedback loop (Bradley et al., 2020). Recognizing and analyzing the feedback loop is imperative to understand and employ corresponding adjustments to the ICPs in terms of effectiveness and efficiency. The developed infection control measures must be tailored to meet the unique needs of facilities involved in the system.

The outcome of infection rates could vary based on the characteristics of the facility despite the same infection control practices being implemented. This study undertakes an examination within the framework of Systems Theory, where inputs are discerned as factors wielding potential influence over the implementation of ICPs. Each of the input components will be examined separately and in combination to evaluate the differences of the COVID-19 infection cases and rates. The analytical outcomes, serve as reflective depictions of the dynamic influence exerted by each individual input (census region, PPEs, size of the facility, and profit/nonprofit statuses of RCCs) on the operationalization of ICPs. Moreover, the establishment of feedback loops becomes instrumental in extracting and targeting significant inputs that can produce adaptive responses. Such responses are pivotal for the continuous improvement and refinement of ICPs within RCCs.

Literature Review

This literature review aims to assess the differences in COVID-19 outcomes based on the characteristics of RCCs (i.e., ICPs, facility size, census regions, PPE shortages, and ownership type: for-profit vs. nonprofit). As the COVID-19 virus continues to evolve and mutate, the preventive measures required to protect the general population must also evolve in accordance with the changing dynamic of the disease among public and healthcare facilities. Research studies on the pandemic showcased how older adult patients were at a higher risk of infection disease than other populations, where study indicated that around 80% of those affected by the virus were 65 and above (Sadarangani et al., 2021). Individuals aged 65 and above reported higher risks of complications after the infection of COVID, and symptoms included respiratory failure, fatigue, hypertension, memory loss, kidney injuries, and cardiac rhythm problems (Abul et al., 2023). Among older adult patients with severe illness caused by COVID-19, especially those with chronic health conditions, were disproportionately affected with death rate as high as 30% (Rowe et al., 2020). The RCC was selected as it comprises a large proportion of the highly susceptible population to the virus (Prendki et al., 2022). Further, the healthcare worker of RCCs should not be excluded, given that workplace-associated exposure can also be hazardous (Sweeney et al., 2022; Juan et al., 2020). Due to the catastrophic impacts of the virus on older adults, the lockdown measures for the older population became much stricter by the local government authorities. However, long-term care was not primarily considered essential services as visitation policies prohibited family members and physicians from entering the facility and providing residents necessary care. Such strict approaches led to inadequate access to essential resources and limited social interaction among patients, resulting in reduced effects of mitigation of COVID-19 in the long-term care sector and contributed to a drastic increase of mortality rate among residents within RCCs and long-term care facilities (Chu et al., 2021; Dawson, 2021).

Complete isolation and restricted movement among older adult patients represented a significant loss of autonomy, resulting in a significant increase of time consumption of staff when monitoring and managing the patients (Gordon et al., 2020). Restrictions on isolation have made it difficult for healthcare staff to provide essential care, disrupt routine medical check-ups, and delay treatment that have been associated with potential health declines among residents. According to Hugelius et al. (2021), visiting restrictions within long-term care facilities can lead to a negative impact among residents and their family members. The impacts on residents' physical health include increased physical pain and reduced ability to perform self-care (Hugelius et al., 2021). There is also a report indicating an increased negative impact on mood disturbance during COVID-19 lockdown (Terry et al., 2020). The impact of isolation and lockdown can vary depending on the local regulations and magnitude of restrictions implemented in the settings (Hugelius et al., 2021; Gordon et al., 2020; Sepúlveda-Loyola et al., 2020). The major impacts caused by isolation and lockdown reported by Sepúlveda-Loyola et al. (2020) were anxiety, depression, poor sleep quality, and physical inactivity across the nation. The long-term consequences of isolation impact will need to be addressed to shape the future responses to similar challenges in the future. To effectively address these challenges, it is essential to tailor ICPs to the specific needs of these diverse residents. When implementing isolation restrictions, decision-makers and policymakers must considernegative impacts and compensate for the effects (Hugelius et al., 2021). One key aspect of addressing the unique needs of the resident population is adapting ICPs for individuals with cognitive impairments, such as dementia. Residents with dementia may have difficulty understanding and adhering to hygiene and social distancing measures. According to NPALS 2020 survey, about 4 in 10 residents were diagnosed with Alzheimer's disease or dementia (42%), about 3 in 10 were diagnosed with heart disease (31%) or depression (29%), and nearly 2 in 10 were diagnosed with diabetes (17%) in RCCs (Caffrey et al., 2022). Facilities should establish specialized protocols for these residents, including additional supervision, visual cues, and personalized care plans to reinforce proper hygiene practices. Another essential aspect of tailoring ICPs is managing and monitoring visitors (Cohen-Mansfield & Meschiany, 2022). Visitors can potentially introduce infections to the care community, and it is vital to implement strategies that minimize this risk. Care communities should develop visitor policies, including screening for symptoms, temperature checks, mandatory hand hygiene, and using personal protective equipment (PPE) when necessary. Limiting the number of visitors, restricting visiting hours, and designing specific areas for visitation can also help reduce the risk of infection transmission and positively affect ICPs (McGinlay et al., 2020). These measures reduce the risk of infection transmission in healthcare facilities. The benefits of these measures include reduced transmission risk to vulnerable populations, controlled flow of visitors, enhanced monitoring and screening, improved compliance with infection control measures, reduced congestion, visitor education, enhanced contact tracing, respect for patient privacy, emergency preparedness, and compliance with regulatory requirements (McGinlay et al., 2020; Arora & Gibson, 2020). However, reduced visitation can lead to unintended consequences associated with depression and anxiety (Sweeney et al., 2022). Coe et al. (2022) reported that there was an increase of depressive symptoms during the implementation of visitation restriction due to the reduced interaction between residents and their visitors in long-term care facilities. The balance between residents' mental health and restrictive strategies should be emphasized in future studies.

Consequently, the COVID-19 pandemic has caused long-term impacts on many countries' healthcare systems, including the United States, as WHO (2023) reported 771,191,203 confirmed COVID-19 cases with 6,961,014 deaths as of October 2023. Due to its high transmissibility via airborne droplets (normal speaking can produce thousands of oral fluid droplets range from *ca.* 1 μm to 500 μm), older adults with multiple health conditions are at greater risk of contracting the virus, potentially leading to severe illness and even death (Stadnytskyi et al., 2020). Since the first case was recognized, studies of hospitalized patients reported fatality rates range from 1.4% to 18.9%, and as high as 61.5% among critically ill patients (McArthur et al., 2020). A more recent study conducted in Midwest of US indicated that the fatality rate among older adults above 65 was as high as 78.2% (Parra et al., 2022). The dramatic rising of confirmed cases imposed a significant burden and challenges on handling inpatient management. Despite public interventions were implemented to manage the spread of the COVID-19 virus, further exploration is needed to ascertain the consistency and effectiveness of these practices (Lee et al., 2020).

Previous research has found various aspects of ICPs to be significantly influential on infection control outcome, such as notification of patient and other caregivers, PPE shortage, and staff education (Rowe et al., 2020). Yet, there remains a need for a more comprehensive understanding of the difference in COVID-19 infection rates and cases based on the characteristics of RCCs (ICPs, PPE shortages, ownership type (for-profit vs. nonprofit), census regions, and RCC size). Exploring various aspects of RCCs will enable researchers and policymakers to gain a deeper understanding on the unique context of these care settings, facilitate the development of targeted interventions and strategies, and improve the overall outcome of infection control. This comprehensive approach can ensure that new policies and interventions are contextually relevant, leading to more effective and successful infection control and prevention within RCCs. Additionally, existing research has predominantly focused on acute care settings, such as hospitals, with limited attention given to the unique challenges and complexities of RCCs. This dissertation aims to address these gaps in the literature by providing an in-depth examination of the difference in COVID-19 infection rates and cases based on the characteristics of RCCs.

Critical components of infection control in RCCs

COVID-19 Symptoms Screening

A well-implemented daily screening program is pivotal in bolstering the effectiveness of infection control measures (Hunter et al., 2020). First, daily screening serves as an early warning system for potential infections. By promptly identifying individuals exhibiting symptoms such as fever or respiratory issues, healthcare providers can swiftly isolate these residents and conduct necessary diagnostic tests. This proactive approach effectively curtails the risk of spreading infectious diseases within the community, minimizing the duration during which an infected individual could contact others (Hunter et al., 2020). Consequently, the impact of an outbreak is significantly mitigated, safeguarding the health and well-being of all residents.

Secondly, daily screening represents a cost-effective strategy in combating COVID-19. Residents and healthcare staff can detect potential cases by monitoring temperature without grappling with the intricate trade-offs between sensitivity, user-friendliness, and costs (Liu et al., 2021). Furthermore, routine monitoring of respiratory symptoms and PCR testing offers a more precise means of tracking COVID-19 cases, facilitating immediate responses to curtail transmission risks (Chin et al., 2020). Continuous monitoring of fever or respiratory symptoms aids in identifying potential outbreaks and evaluating the efficacy of existing ICPs (Yombi et al., 2020). This valuable information guides decision-makers in adapting or introducing new measures to enhance infection control. For instance, increased symptoms may signal the need for additional staff training or stricter enforcement of personal PPE protocols.

In addition, daily screening fosters heightened awareness among residents and staff regarding the paramount importance of infection control (Gohil et al., 2021). By underscoring the necessity of regular symptom checks, RCCs create an environment where all members are acutely conscious of their role in preventing the spread of infections. This heightened awareness can translate into improved adherence to vital ICPs, including rigorous hand hygiene, proper respiratory etiquette, and PPE utilization. Moreover, daily screening facilitates prompt medical evaluation and treatment for residents exhibiting fever or respiratory symptoms. Early intervention mitigates the severity of illness, prevents complications, and enhances overall health outcomes for affected individuals (Gohil et al., 2021). Timely medical care also contributes significantly to infection control efforts by reducing the window during which a symptomatic person could transmit the disease to others.

Daily screening for fever or respiratory symptoms is critical in preventing infectious disease transmission within healthcare settings. The World Health Organization (WHO) underscores the importance of daily symptom screening as a pivotal measure for minimizing and controlling the spread of COVID-19 within healthcare facilities (WHO, 2021). Screening serves as a cornerstone in identifying individuals who may be infected, effectively interrupting transmission chains. A 2021 study affirmed the efficacy of daily screening in hospitals, revealing that patients with COVID-19 symptoms had a significantly higher positivity rate (21.6%)

compared to asymptomatic patients (17.0%) (Nuertey et al., 2021). Furthermore, screening for infectious diseases before medical procedures proves indispensable in reducing adverse patient events, curbing further transmission, conserving PPE, and enhancing hospital system efficiency (Sadat & Muhammad, 2020).

The Centers for Disease Control and Prevention (CDC) aligns with this view, endorsing daily screening for fever or respiratory symptoms as an integral part of their infection control guidelines for long-term care facilities (CDC, 2022). Early detection and isolation of infected individuals are robust safeguards against outbreaks in these settings. A recent study by Kim et al. (2022) lends further support, suggesting that daily screening through COVID symptom attestation effectively identified COVID cases, even among participants who were predominantly asymptomatic (99.9%) or exhibited minor symptoms of COVID-19. In summary, a well-executed daily screening program is a cornerstone of infection control, offering early detection, cost-effectiveness, heightened awareness, and timely intervention. These benefits protect the residents and contribute to the overall success of infection control efforts in healthcare and residential care settings.

COVID-19 Case Notification

One important measure for infection control in an RCC is the timely notification of all residents or families in the event of a confirmed case of a contagious disease (Flynn, 2020). This method is crucial as it helps to ensure the timely identification and isolation of infected individuals and provides transparent communication to residents and their families. Study conducted in Pakistan showed that case notification was effective in facilitating subsequent actions to minimize the transmission of Tuberculosis (TB) during COVID-19, leading to 45% decreases in case notifications for susceptible TB patients (Malik et al., 2022). The Centers for

Medicare and Medicaid Services (CMS) required nursing homes to notify residents and their families of the occurrence of a single confirmed or suspected case of COVID-19 to ensure that families are informed in a timely manner and can take necessary precautions to protect themselves and their loved ones (Flynn, 2020). This approach can contribute to the overall success of infection control measures in several ways. First, notifying residents and families within 24 hours of a confirmed case promotes trust and confidence in the management of the RCC.

Open communication about the presence of infections within the community ensures that residents and their families know the situation, allowing them to make informed decisions and take necessary precautions. This transparency helps maintain positive relationships between the RCC and its stakeholders, creating an environment where everyone is more invested in maintaining a healthy community (Ihlen et al., 2022; Flynn, 2020). It also enhances the awareness and vigilance of residents, families, and staff. When all parties are informed of a case, they are more likely to strictly adhere to ICPs, such as hand hygiene, respiratory etiquette, and proper use of PPE. This heightened awareness can lead to a reduction in the spread of infections within the RCC. An enactment called by the AARP Public Policy Institute in 2020 found that family members of nursing home residents rated timely communication about COVID-19 cases as the most important factor in determining the quality of care provided by the facility (AARP Nursing Home COVID-19 Dashboard, n.d.). Farrell et al. (2021) study found differences in COVID-19 transmissions based on automated notification via text and telephone if timely notification was disseminated within 24 hours. The implementation of digital notification enabled more timely notification of confirmed COVID cases in North Carolina state, resulting dramatic increase of timely notification within 24 hours from 15% to 56% in January 2021

(Farrell et al., 2021). Overall, timely notification of residents and families of cases in an RCC is an effective infection control method in providing guidance on isolation, instructions on informing close contacts, and telephone numbers to call for assistance. Transparent communication can help build trust and confidence in the facility's response to an outbreak and can facilitate timely identification and isolation of infected individuals, leading to improved infection control measures and outcomes.

Thirdly, notifying residents and families within 24 hours enables them to take appropriate actions, such as monitoring their health or the health of their loved ones and seeking medical advice if necessary (Behera et al., 2020). This proactive approach can contribute to the early detection of potential infections, allowing for prompt medical intervention and reducing the risk of further transmission. However, it is crucial to recognize that notifying residents and families within 24 hours is only one aspect of an effective infection control program. While it fosters transparency, trust, and vigilance, other ICPs must also be in place. These ICPs include a daily screening of residents for fever or respiratory symptoms, staff training on infection prevention and control, proper use of PPE, environmental cleaning and disinfection, and developing and implementing outbreak management plans. Abueg's study (2020) found that facilities with early notification of COVID-19 cases via technology had fewer infections and deaths by approximately 6%-8% compared to those with traditional tracing techniques. Another study showed significant differences in the infectious cases of COVID-19 based on identification of a point of contact and prompt notification due to patients' higher prevalence of chronic conditions and the congregate nature of assisted living facilities (Yi et al., 2020). As of October 2020, the report indicated that 22% of assisted living facilities had at least one confirmed COVID-19 case among residents or staff members, and among those facilities, the proportion of fatal cases was as high as 21.2% for residents (Yi et al., 2020). Case notifications via decentralized contact tracing application (United Kingdom's National Health Service COVID-19 App) revealed significant differences of infectious cases of COVID-19 with every 1% increase in the number of downloads led to a 0.8%-2.3 reduction of numbers in COVID cases (Pandit et al.,2022).

Use of telephone or audio-only Calls

The use of telephone or audio-only calls to assess, diagnose, monitor, or treat residents with presumptive positive or confirmed COVID-19 infection has emerged as a viable solution to manage the pandemic's challenges (Benjenk et al., 2021). According to the study conducted by Thomas et al. (2020), the proportion of utilizing telephone and virtual consultation increased from 0.2% to 35% in April 2020 in Australia. Wolthers & Wolthers et al. (2020) interview reported that 97 out of 100 participated families (97%) agreed or strongly agreed to have the substitute of telephone consultation during COVID-19. The survey conducted by Heyck Lee et al. (2022) showed that telephone consultation was comfortable for 68% of the participants, and 73% felt it was a safer alternative for accessing healthcare during pandemic. This approach has several advantages, such as reducing exposure for healthcare providers and patients, conserving PPE, and providing accessible care for patients in remote or underserved areas. By minimizing direct physical contact, healthcare providers can limit the risk of transmission and protect themselves and other patients from potential infection. Furthermore, adopting ICPs can help alleviate the burden on healthcare facilities by allowing providers to manage a more significant number of cases remotely, thus reserving in-person care for the most severe cases. However, it is essential to recognize the limitations of telephone or audio-only calls in accurately diagnosing and assessing patients' conditions, as visual cues and physical examinations are impossible. Additionally, the effectiveness of this approach may vary depending on factors such as patients' access to technology, comfort with telecommunication, and the severity of their symptoms (Goenka et al., 2021; Pierce & Stevermer, 2020). While telephone or audio-only calls offer a valuable tool to manage COVID-19 cases, it is important to consider their limitations and ensure they are used appropriately and in conjunction with other diagnostic and treatment methods.

The use of telephone or audio-only calls to assess, diagnose, monitor, or treat residents with presumptive positive or confirmed COVID-19 infection was widely adopted infection control method during the pandemic (Thomas et al., 2020). This method is effective for reducing the risk of transmission to healthcare workers and other residents in long-term care facilities, and for improving clinical outcomes. Jen et al. (2021) found that virtual visits were effective in managing COVID-19 cases in long-term care facilities, resulting in high patient satisfaction, reduced exposure to the virus, and improved clinical outcomes.

Use of telehealth

The use of telehealth, such as web videoconferencing, to assess, diagnose, monitor, or treat residents with presumptive positive or confirmed COVID-19 infections has emerged as a practical and effective solution to address various challenges posed by the pandemic (De Simone et al., 2022; Pandit et al.,2022; Thomas et al., 2020). This technology not only reduced exposure between healthcare providers and patients, but also indicated high satisfaction rate (80%) among patients using telehealth services (Thomas et al., 2020). By conducting remote consultations, healthcare professionals can safely assess, diagnose, and monitor patients with COVID-19 symptoms while limiting the spread of the virus. Secondly, this technique conserves available resources sources; utilizing telehealth services can help conserve PPE, which is vital for healthcare providers to continue working with infected patients in a safer environment (Garfan et al., 2021). By reducing in-person visits, the demand for PPE decreased, allowing for a more efficient allocation of resources (Hick et al.,2020). Telehealth also expanded access to healthcare services, particularly for patients in remote or underserved areas who may struggle to access medical facilities. By leveraging technology, it can help patients to receive prompt medical attention and guidance, which is critical for managing COVID-19 symptoms and reducing the strain on local healthcare systems. Several studies support the effectiveness of telemedicine in managing COVID-19 cases. For example, Mann et al. (2020) study found significant increase of telehealth utilization in Emergency Department (ED) in response to the COVID-19. The telehealth platform provided paralleled services and access to patients while the satisfaction among patients were maintained surprisingly high (mean satisfaction = 4.38/5 despite the rapid uptake of telehealth by virtually inexperienced providers). On the other hand, Garfan et al. (2021) study also concluded there needed to be more regulations, guidelines, and integration of utilizing telehealth. Improving data security and privacy are key factors for users deciding whether to adopt the technology or not (Garfan et al., 2021). Regulations about data security and integration should be adaptive, considering technology evolving and potential risks while high quality and seamless data exchanges are provided to healthcare professionals.

The CDC and WHO recommended using telehealth to manage the COVID-19 (WHO, 2021; CDC, 2022). The CDC recommends the use of telehealth services to manage COVID-19 cases in long-term care facilities to reduce the risk of transmission to healthcare workers and other residents (CDC, 2022). The WHO also recommends the use of telemedicine to manage COVID-19 cases in healthcare settings, as it can reduce the risk of transmission to healthcare workers and other patients, and conserve PPE and other medical supplies (WHO, 2020).

Communal Space Limitation

Limiting communal dining and recreational activities in common areas can contribute to the effectiveness of infection control in several ways. One of them is reducing close contact between residents (de Rosa & Mannarini, 2021). By discouraging gatherings in common areas, the risk of person-to-person transmission is significantly reduced. This is particularly important in residential healthcare settings with vulnerable populations, such as older adults or those with pre-existing health conditions (Parekh & Daniels, 2021). Minimizing vulnerable populations' exposure to potential virus carriers protects their health and well-being. Another advantage of implementing these restrictions is the facilitation of social distancing. By enforcing measures such as staggered mealtimes or designated areas for individual recreational activities, residential healthcare facilities can promote physical distancing among residents. This practice helps to mitigate the risk of infection transmission further, as maintaining a safe distance from others can reduce the likelihood of respiratory droplets carrying the virus from one person to another (Issakhov et al., 2021).

Moreover, limiting communal activities in residential healthcare settings encourages residents to practice good personal hygiene. The absence of shared dining spaces and recreational facilities reduces the number of high-touch surfaces, which can serve as transmission points for viruses. Encouraging residents to spend more time in their private living quarters allows for better control over their immediate environment and personal hygiene practices, such as frequent handwashing, further minimizing infection risks.

Personal protective equipment (PPE)

PPE can be an essential tool in preventing the spread of infections in RCCs. However, the effectiveness of PPE alone in ICPs depends on several factors, including proper usage, availability, and adherence to other infection control measures (WHO, 2020; Mahmood et al.,2020). While PPE, such as gloves, masks, and gowns, can provide a physical barrier to prevent the spread of infections, it is essential to note that they should not be relied upon as the sole measure of infection control. Other measures, such as hand hygiene, environmental cleaning, and social distancing, should also be implemented to reduce the risk of transmission. Proper usage of PPE is crucial for it to be effective in infection control. This includes ensuring that the PPE is used in the correct sequence, properly fitted, and not contaminated during use. The result of survey conducted with 248 healthcare workers highlighted the importance of PPE in terms of fit and tolerability, indicating that 55.7% of participants had been hampered in their role by PPE which could substantively impact their safety and efficiency at the work (Janson et al., 2022). Elaborating on the proper use of PPE can also avoid and prevent unnecessary waste, which was extremely important during the outbreak of COVID-19 when PPE shortage became a global issue. The availability of PPE can also impact its effectiveness in infection control. Care communities should have an adequate supply of PPE to protect staff and residents, particularly during increased demand, such as during outbreaks or pandemics. In order to deliver safe care, PPE and the training of its use was critical to protect the healthcare staff in providing patient-centered care. Inadequate protection among healthcare staff can pose both moral and ethical dilemmas when delivering care is not safe and leading to work force stress (Herron et al., 2020). In response to the transmission of various pathogens, it was imperative to understand the use of appropriate PPEs. According to the study conducted in Singapore, the result suggested that surgical mask was effective in preventing the transmission of virus where healthcare workers were infected when treating COVID confirmed patients (Stewart et al., 2020). Other protective equipment such as gowns, gloves, and goggles were also critical in preventing viruses via aerosol and droplets.

Moreover, staff should receive regular training on how to use PPE appropriately, including wearing goggles, gowns, gloves, and surgical caps. A survey conducted by John et al. (2017) indicated only 41% of the participants (medical students) were reported to have received proper PPE training and none had been required to demonstrate proficiency. 92.5% of participants showed unproficiency in techniques and 44% showed contamination on their skin with fluorescent lotion (John et al., 2017). A recent study conducted by Haegdorens et al. (2022) illustrated that sufficient PPE training can help to reduce COVID-19 infections among healthcare workers, suggesting prompt dissemination of PPE usage guideline to improve the knowledge among healthcare practitioners. Proper and adequate training on PPE usage is essential not only for the prevention of virus transmission but also for the conservation and consumption of PPE resources.

Size of the Facility

There is a difference in the number of COVID-19 cases based on the size of an organization (He et al., 2020). Larger organizations, particularly healthcare facilities, are more likely to have more people and shared spaces, increasing the transmission risk. However, Bhadra et al. (2020) introduced another aspect to this discussion, stating that there is a significant difference in COVID-19 spread due to the population density within the facility, regardless of the facility's total size. Liljas et al. (2022) study suggests that larger facilities are more likely to have disease outbreaks; however, the risk of larger outbreaks tends to be lower in some larger facilities. The inclination toward reduced virus transmission is 50% lower due to facility design, and 2.5 times lower through staff compartmentalization. This finding implies that even if the facility is enormous if it houses a dense population, the risk of transmission increases. The virus spreads through respiratory droplets, so closer interactions and reduced distances facilitate easy transmission. In addition, McGarry et al. (2021) highlighted the importance of nursing homes, where more extensive facilities have more communal areas such as dining halls, lounges, or activity areas, leading to higher COVID-19 cases.

Larger facilities could also influence the adherence of the ICP measures (Wachholz et al., 2022). According to the Wachholz et al. (2022), larger facilities tend to exhibit lower adherence to screening symptoms of visitors (p=0.037), and isolating patients until they obtain two consecutive negative tests results (p=0.032) when comparing to the medium and small facilities. Effective management of infection control associated with size is more complex in terms of increased number of bed capacity, staff size, and physical infrastructure (He et al., 2020; Liljas et al., 2022; Plagg et al., 2021). The scale and complexity of larger facilities can introduce unique challenges in maintaining and managing the operations of robust infection control measures within the long-term care facilities. Factors such as number of staff and residents, and patient turnover may impact the adherence and effectiveness of the ICPs (He et al., 2020; Plagg et al., 2021; Bhadra et al., 2020). Thus, comprehending and addressing these distinctions are essential in improving the overall outcomes of ICPs in long-term care facilities.

Ownership Type

Several studies conducted by Lu et al. (2021), Harrinton (2020), Stall et al. (2020), and Liu et al. (2020) showcased that for-profit facilities have higher rates of COVID-19 cases and deaths among residents than nonprofit facilities. Stall et al. (2020) found that profit long-term care facilities (85.1 per thousand) had the highest number of cumulative incidences of COVID-19 comparing to nonprofit (61.4 per thousand) and municipal homes (23.4 per thousand).

Resource allocation, understaffing, and limited resources for infection control measures are some of the primary reasons for this disparity (McGregor & Harrinton, 2020). For-profit facilities, in particular, prioritize cost-saving efforts that could compromise patient care quality, leading to lower staffing levels and less familiarity with infection control protocols than nonprofit organizations (Stall et al., 2020). Additionally, for-profit facilities may prioritize shareholder returns over reinvesting their revenues into the facility, resulting in worse infrastructure, equipment, and patient care amenities than nonprofit organizations (Liu, 2020). Furthermore, for-profit facilities may admit patients with more severe health conditions, making them inherently more susceptible to adverse outcomes if they contract COVID-19 than nonprofit organizations (McGregor & Harrinton, 2020).

Profit-driven motives could influence decisions, potentially at the expense of patient care or safety measures, and the decision-making process in for-profit entities might be more bureaucratic or influenced by financial considerations than in nonprofit organizations, potentially delaying critical responses during crises (Liu, 2020). Compliance rates with established infection control protocols are typically lower in for-profit nursing homes than nonprofit homes. Finally, the level and type of oversight and the regulatory environment can differ between for-profit and nonprofit facilities, potentially influencing care quality and outcomes (Stall et al., 2020).

Geographical Location

Geographical location can play a significant role in impacting the result of infection control practices and infection outcomes (Yang et al., 2021). The climate and seasonal variations associated with geographical location can influence the survival and transmission of the virus. The study suggested that the influence of meteorological factor associated geographical location had significant impact ($p<0.001$) on the COVID019 transmissions (Yang et al., 2021). Chu et al.

(2023) also found positive relationship between daily mean temperature and mortality associated with COVID-19 infection; there was an increase of 11% death rate when daily mean temperature rose to 90th percentile from the local median (Chu et al., 2023). Moreover, geographical disparities existed in healthcare resources and capacity (Blundell et al., 2020). The study result indicated that the death rate was more than double in the most deprived area comparing to the least deprived area in the UK (Blundell et al., 2020). The systematic-review conducted by McGowan & Bambra (2022) showed that 86 out of 95 articles reported higher COVID-19 mortality rate in areas of social disadvantage comparing to affluent areas. Inequalities of medical resources and equipment availability in healthcare sector was sharpened during COVID-19 as demand of these resources were significantly increased to manage the transmission of the virus (Blundell et al., 2020).

Culture norms and compliance variation associated with geographical location, including culture diversity and societies historical exposure to disease-causing pathogens can also affect the public infection regulations and measures established by the local government (Chen et al., 2021). Such variation can lead to the inconsistency of ICPs adoption, and the quality of care provided in healthcare settings (Althouse et al., 2020). For example, most of the countries-imposed stay-at home mandate (increased by forty percent) at the peak of the outbreak in early 2020, while some countries delayed or did not impose any policies to promote the isolation (around ten percent) (Chen et al., 2020). In addition, geographical disparities in access to the COVID-19 messaging and testing had revealed significant challenges, particularly within communities of color (Tan et al., 2020; Bambra et al., 2020). Evidence showed that 59.2% of COVID-19 deaths were among black communities in Chicago and the mortality rate of black Chicagoans was almost quadrupled compared to white community (Bambra et al., 2020). The analysis conducted in Massachusetts found that the mortality rate is 40% higher in cities and towns characterized by elevated poverty level (weighted average threshold for one person and two people are, $14,880 and $18,900, respectively) and higher percentage of populations of color during COVID-19 (Tan et al., 2020; US Census Bureau, 2022).

Challenges and considerations

Policies and regulations

One challenge from regulatory variations is the potential for confusion or misinterpretation of requirements by facility administrators and staff. There is growing number of literatures revealing that lack of credible resources of information can result in misunderstanding of the information and leading to complete failure of communication effort and regulation establishment (Salwa et al., 2022). This shortfall can lead to lapses in ICPs, as facilities might need to fully understand and implement the necessary measures (Cohen et al., 2015). To address this challenge, facilities must stay updated on the latest regulatory changes and seek clarification from relevant authorities when needed, such as the CDC. Regular training and education of staff members on regulatory requirements can also help improve compliance. Facilities can better implement and maintain the necessary measures by ensuring staff know the specific regulations and their implications for ICPs.

Another challenge associated with variations in enforcement is the potential for disparities in the quality of care provided by different facilities (Chow & Guo, 2023). Inadequate enforcement can result in some facilities failing to adhere to established infection control standards, putting residents and staff at risk. Moreover, variation and fragmentation in regulation and policy enforcement across different regions could result in disparities in the outcome of infection control (Chow & Guo, 2023). To address this issue, regulatory agencies and policymakers must conduct regular inspections and audits of RCCs to assess their compliance with infection control measures and facilitate to tailor regulations that address specific challenges if needed (Stone et al., 2016). When non-compliance is identified, regulatory agencies should work with facilities to address the shortcomings and ensure appropriate corrective actions are taken. They might need to provide guidance, resources, and support to help facilities improve their ICPs. By doing so, the public health system can foster resilience and effectively mitigate the crisis (Lal et al., 2020).

In some cases, penalties or sanctions might be necessary to encourage compliance and protect the health and safety of residents and staff (Herzig et al., 2016). Collaboration between regulatory agencies, facility administrators, and staff is crucial for addressing the challenges posed by regulatory requirements and enforcement variations. By working together, these stakeholders can help ensure consistent and effective ICPs across RCCs, thereby protecting the health and well-being of residents and staff.

Summary

The dissertation explored the differences in COVID-19 infection rates and cases based on the characteristics of RCCs, such as ICPs, PPE shortages, ownership type (for-profit vs. nonprofit), census regions, and RCC size. The paper highlighted the importance of the characteristics of RCCs in maintaining the health and well-being of residents, particularly vulnerable populations. Theoretical and conceptual frameworks helped understand the difference in COVID-19 infection rates and cases based on the characteristics of RCCs. Researchers can develop interventions to overcome barriers using the frameworks. Applying Systems Theory to the practices provided a comprehensive framework for analyzing, designing, and implementing effective interventions considering RCCs' interconnectedness and dynamic nature. The study highlighted common barriers to ICPs, such as limited resources, time constraints, and lack of knowledge. The paper concluded by discussing how Systems Theory could help evaluate infection controls holistically, emphasizing the importance of considering all aspects of the RCCs. To properly implement each infection control measure, it is also essential for researchers and policymakers to understand the complexities and challenges faced by residential care settings. To address the challenges, facilities must stay updated on the latest regulatory changes and seek clarifications from relevant authorities to ensure the effectiveness of infection control measures.

CHAPTER THREE: METHODOLOGY

Overview

The chapter presents the methodology used to examine the differences in COVID-19 infection rates and cases based on the characteristics of RCCs (ICPs, PPE shortages, ownership type (for-profit vs. nonprofit), census regions, and RCC size). The characteristics of RCCs are influential in preventing the spread of infectious diseases among residents and staff, as their poor measures can lead to severe health consequences. The COVID-19 pandemic, which began in early 2020, affected the study's data collection.

The pandemic led to many RCCs implementing new ICPs and guidelines, which may have impacted their responses to the questionnaire. Additionally, some RCCs were temporarily closed, understaffed, or overwhelmed by COVID-19 outbreaks, making it challenging to participate in the study (Chen et al., 2020). To adapt to the situation, the researchers of NPALS added new questions to the questionnaire to assess the COVID-19 experience and modified other questions. The researcher also delayed the study's data collection due to the pandemic's impact on RCCs. The changes and delays affected the study's findings and should be considered when interpreting the results. The study used a questionnaire to collect data on residents and ICPs adoptions within RCCs, developed based on guidelines from organizations like the CMS and the CDC.

The chapter begins by describing the study design and sampling methods used to obtain the data, followed by an overview of the data collection procedures. The chapter then discusses the variables in the analysis and any data cleaning and preprocessing procedures performed. Finally, the chapter outlines the statistical methods used to analyze the data and presents the result analysis. The chapter aims to give readers a clear understanding of the research methods used and how they contributed to the findings presented. One of the study's limitations was using a self-reported questionnaire survey, which may have led to response bias or inaccurate reporting (Young et al., 2019). The researcher may not generalize the study's findings to other countries or settings. Future research could employ a longitudinal study design to assess changes in an ICP over time and examine the impact of interventions on improving infection control in RCCs.

Design

The COVID-19 pandemic has significantly affected people worldwide, especially older people who reside in RCCs (CDC, 2022). Given the high transmission and mortality rates associated with the virus, it is critical to investigate the differences in COVID-19 infection rates and cases based on the characteristics of RCCs. To achieve the goal, the researcher used secondary data from the COVID-19 study conducted by the NPALS and CMS. The datasets were necessary because it contained the study variables. The research questions included adoption of ICPs, PPE shortages, ownership type (for-profit vs. nonprofit), census regions, RCC size, and COVID-19 infection rates and cases in RCCs.

The study involved an ANOVA to explore the differences in COVID-19 infection rates and cases based on the characteristics of RCCs. The first step in the process was to identify and obtain a suitable dataset from the COVID-19 study that contained variables like ICPs, PPE shortages, ownership type (for-profit vs. nonprofit), census regions, RCC size, and COVID-19 infection rates and cases in RCCs. The second step was to check for outliers and missing values and use appropriate statistical tests and methods to account for any issues with data quality.

The third step involved performing assumption tests to check normality and homogeneity of variance. Finally, the study employed ANOVA and factorial ANOVA to test the research questions. For instance, the study used one-way ANOVA to analyze the differences in COVID-

19 infection rates and cases based on ICPs. A one-way ANOVA is most appropriate for examining differences in a continuous dependent variable between the means of independent groups. In addition, the researcher used three-way ANOVAs to examine the differences in COVID-19 infection cases and cases based on ownership type (for-profit or nonprofit), ICPs, and PPE shortages. A three-way ANOVA is suitable for determining an interaction effect between three independent variables on a continuous dependent variable. Lastly, the four-way ANOVA and five-way ANOVA were used to examine the differences in COVID-19 cases based on census region, ICPs, PPE shortages, facility size, and ownership type (for-profit or nonprofit).

Research Question(s)

RQ1: Is there a significant difference in the adoption of ICPs in reducing COVID-19 cases in RCCs?

RQ2: Is there a significant difference between for-profit and nonprofit centers' infection control practices, PPE shortages, and COVID-19 cases?

RQ3: Is there a significant difference in infection control practices, PPE shortages, and COVID-19 cases between facilities in different census regions?

RQ4: Is there a significant difference between small, medium, and large-sized facilities' infection control practices, PPE shortages, and COVID-19 cases among patients in residential care communities during COVID-19?

Hypothesis Study

H_1. There are statistically significant (*p value*< 0.05) differences in the adoption of ICPs in reducing COVID-19 cases in RCCs.

H_2. There is a statistically significant (*p value* < 0.05) difference between for-profit and nonprofit centers' infection control practices, PPE shortages, and COVID-19 cases.

H_3. There are statistically significant (*p value* < 0.05) differences in ICPs, PPE shortages, and COVID-19 cases between RCCs in different census regions.

H_4. There are statistically significant (*p value* < 0.05) differences between small-, medium-, and large-sized RCCs' ICPs, PPE shortages, and COVID-19 cases.

Participants and Setting

The study investigated the differences in COVID-19 infection rates and cases based on the characteristics of RCCs. The CDC used a questionnaire with closed-ended questions and anonymized all data to ensure privacy and confidentiality. By identifying differences in COVID-19 infection rates and cases based on the characteristics of RCCs, healthcare providers can reduce the risk of infections among RCC patients. The findings may improve COVID-19 outcomes and reduce disease incidence in RCC settings.

Data Sources

The 2020 NPALS conducted between November 2020 and July 2021 aimed to assess study eligibility and collect data on RCCs and adult day services centers (National Center for Health Statistics, 2022). The 2020 NPALS survey RCC component utilized a combination of samples and censuses in different states as part of its research initiative to gather information and data on post-acute and long-term care services in the United States. This survey aimed to collect comprehensive information on various aspects of healthcare and services provided in different care settings, including RCCs. To collect data from RCCs, the survey organizers (NPALS) used a combination of two primary data collection methods: sampling and censuses. Sampling involves selecting a subset of individuals or facilities from a larger population for data collection, which allows researchers to gather information from a representative sample rather than attempting to survey the entire population (healthcare providers and residents) within RCCs. NPALS used a multi-mode survey protocol to collect data, including mail, web, and telephone. The survey included items on provider characteristics and in addition to aggregate user characteristics, such as the number of residents needing assistance with activities of daily living. A total of 4,312 residential care communities completed surveys.

The second dataset reported the CDC's National Healthcare Safety Network (NHSN) COVID-19 Module (CMS, 2023). While the NHSN module did not mandate a standardized sampling method, it provided a uniform system for RCCs to report cases, deaths, and related data. The NHSN module enabled facilities to enter data on resident and staff cases, deaths, testing, and shortages of supplies, thus supporting the nation's COVID-19 response through comprehensive surveillance of its impact on residents and staff of RCCs.

Instrumentation

The CDC implemented the NHSN COVID-19 Module to aid in the reporting of COVID-19-related data and to monitor the virus. The NHSN COVID-19 module made it easy for RCCs to report data on COVID-19 by following the NHSN's component. The NHSN COVID-19 module allowed facilities to report data such as RCCs' size, ownership, geographic locations, ICPs, PPE, COVID-19 infection rates and cases, hospitalizations, and deaths in RCCs. RCCs could report data every week, with the option of manually entering the data into the NHSN web-based application or submitting it in batches.

The questionnaire consisted of the provider survey, the health citations survey, and the facility survey (NPALS, 2020). The survey focused on RCCs' size, ownership, and location. The health citations survey dealt with ICPs, while the facility survey covered PPE shortages, COVID-19 infection rates and cases, hospitalizations, and deaths in RCCs (NCHS, 2022).

The health citations survey assessed ICPs in RCCs. The researcher used the health citations survey to examine the differences in COVID-19 infection rates and cases based on ICPs in RCCs. The facility survey served a dual purpose during the COVID-19 pandemic (NCHS, 2022). First, the facility survey aimed to assess the use and accessibility of PPE in RCCs while also investigating the number of COVID-19 infections and cases, hospitalizations, and deaths in RCCs (NCHS, 2022). The facility survey included inquiries on the availability of various PPE types (e.g., gloves and gowns) and PPE shortages during the pandemic (NCHS, 2022). In addition, the facility survey gathered data on the total number of confirmed COVID-19 cases, infection rates per 1,000 people, hospitalizations, and fatalities among residents and staff in each RCC. The facility survey provided a comprehensive view of COVID-19, such as infection rates, cases, hospitalizations, and deaths (NCHS, 2022). The researcher used the facility survey to examine the differences in COVID-19 infections and cases based on PPE shortages.

Two datasets were merged by combing the common identifiers using matched characteristics of the RCCs (variables including size, PPE shortage, census region, adoption of ICPs, and ownership). The identifier allows for seamless and accurate alignment from each source. Since the researcher used pre-existing sources, there was no need to conduct an informed consent process. Therefore, there was no risk of harm or breach of confidentiality to any individual. Two datasets used in the research were from publicly available sources, and the researcher ensured the privacy and anonymity of all individuals involved in the data collection throughout the study.

Procedures

Ethical Consideration

IRB approval was obtained on March 25th, 2023 (IRB-FY22-23-1585). It is considered as no human subject research as all the datasets were publicly available and no identifications of person or agencies were involved. However, the researcher was still mindful of the ethical considerations involved in using previously collected data and ensured that the analysis and reporting of the data complied with established ethical guidelines. The use of secondary data for research purposes followed strict conditions and restrictions provided by NPALS (NCHS, 2022). The conditions included:

- Using the dataset for statistical reporting and analysis only.
- Making no use of the identity of any person or establishment discovered inadvertently.
- Reporting any apparent errors to the Long-Term Care Statistics Branch (LTCSB) if found.

The study adhered to strict guidelines to ensure the confidentiality and privacy of individuals and establishments involved in the dataset. Firstly, the researcher only used the data for statistical reporting and analysis purposes, without using the information for other purposes such as marketing or commercial gain. Secondly, this study did not attempt to identify any person or establishment within the dataset, including any attempt to link the dataset with other individually identifiable data from other CMS datasets. The researcher did the anonymization by removing identification of personal information to avoid compromising the privacy and confidentiality of individuals and establishments involved, making them vulnerable to possible harm.

Statistical Analytic Plan

The appropriate statistical analysis for the study was an ANOVA to investigate the differences in COVID-19 infection rates and cases in RCCs based on the characteristics of RCCs. An ANOVA allows for examining the difference in a dependent variable based on multiple independent variables. As the study explored the differences in COVID-19 infection rates and cases in RCCs based on the characteristics of RCCs, an ANOVA approach is deemed appropriate.

The researcher used a one-way ANOVA to analyze the differences in COVID-19 infection rates and cases in RCCs based on ICPs to address the first research question. Specifically, the independent variable was ICPs, while the dependent variables were COVID-19 infection rates and cases. Assumption tests assessed normality and homogeneity of variance. The researcher reported the effect size using partial eta-squared (ηp^2), with an effect size of 0.01 being considered small, 0.06 being medium, and 0.14 being large. The alpha level for this analysis was 0.05.

To test the second research question, the researcher examined the differences in COVID-19 infection rates and cases in RCCs based on ownership type (for-profit or nonprofit), ICPs, and PPE shortages. A three-way ANOVA examined the difference, with ownership type, ICPs, and PPE shortages as the independent variable and COVID-19 infection rates and cases as the dependent variables. The researcher performed assumption tests to check for normality and homogeneity of variance. The researcher reported the effect size using partial eta-squared (ηp^2). The alpha level for this analysis was 0.05.

To test the third research question, the researcher examined the differences in COVID-19 infection rates and cases in RCCs based on census region, ICPs, PPE shortages, and ownership type (for-profit or nonprofit). A four-way ANOVA examined the differences, with census region, ICPs, PPE shortages, and ownership type as the independent variables and COVID-19 infection rates and cases as the dependent variables. The researcher performed assumption tests to check for normality and homogeneity of variance. The researcher reported the effect size using eta-squared (η^2), with an effect size of 0.01 being considered small, 0.06 being medium, and 0.14 being large. The alpha level for this analysis was 0.05.

To test the fourth research question, the researcher examined the differences in COVID-19 infection rates and cases in RCCs based on facility size, ICPs, PPE shortages, census region, and ownership type (for-profit or nonprofit). A five-way ANOVA examined the differences, with facility size, ICPs, PPE shortages, census region, and ownership type as the independent variables and COVID-19 infection rates and cases serving as the dependent variables. The researcher performed assumption tests to check for normality and homogeneity of variance. The researcher reported the effect size using eta-squared (η^2), with an effect size of 0.01 being considered small, 0.06 being medium, and 0.14 being large. The alpha level for this analysis was 0.05.

Summary

The chapter outlined the methodology for investigating the differences in COVID-19 infection rates and cases based on the characteristics of RCCs. The chapter described the study design, sampling methods, data collection procedures, variable analysis, and statistical methods used to analyze the data. The researcher considered ethical considerations and maintained privacy protection throughout the study.

CHAPTER FOUR: FINDINGS

Overview

The purpose of this study was to assess the differences in COVID-19 infection rates and cases based on the characteristics of RCCs (i.e., ICPs, facility size, census regions, PPE shortages, and ownership type: for-profit vs. nonprofit) using ANOVA and factorial ANOVA. Chapter 4 will discuss the findings of the research based on the ANOVA analysis result. Additionally, this chapter will present descriptive statistics with summary of dependent and independent variables, and explore the assumptions and hypothesis testing to address the research questions.

Research Questions

RQ1: Is there a significant difference in the adoption of ICPs in reducing COVID-19 cases in RCCs?

RQ2: Is there a significant difference between for-profit and nonprofit centers' infection control practices, PPE shortages, and COVID-19 cases?

RQ3: Is t there a significant difference in infection control practices, PPE shortages, and COVID-19 cases between facilities in different census regions?

RQ4: Is there a significant difference between small, medium, and large-sized facilities' infection control practices, PPE shortages, and COVID-19 cases among patients in residential care communities during COVID-19?

Alternative Hypotheses

H_{1a}. There are statistically significant (*p value*< 0.05) differences in the adoption of ICPs in reducing COVID-19 cases in RCCs.

H_{2a}. There are statistically significant (*p value*< 0.05) differences between for-profit and nonprofit RCCs' ICPs, PPE shortages, and COVID-19 cases.

H_{3a}. There are statistically significant (*p value*< 0.05) differences in ICPs, PPE shortages, and COVID-19 cases between RCCs in different census regions.

H_{4a}. There are statistically significant (*p value*< 0.05) differences between small-, medium-, and large-sized RCCs' ICPs, PPE shortages, and COVID-19 cases.

Descriptive Statistics

This study analyzed the census region variable, the organizational or facility status, ICPs, PPE shortages, the size of the facility, and the COVID-19 infection rate and case variables. To achieve this, the dataset divided the census region variable into four distinct regions: Northeast, Midwest, South, and West. Further, the researcher categorized the organizational or facility status into three classifications: profit, non-profit, and government. Additionally, the researcher used ICPs as a binary variable, denoting whether an organization had implemented these protocols during the data collection phase. Further, the researcher categorized the size of the facility into three sizes: small, medium, and large, based on the number of beds.

This assessment aimed to ascertain whether organizations had encountered a shortfall in the availability of essential PPE, thereby offering insight into the potential impact of such deficiencies on the incidence of COVID-19 cases. In this context, the assessment investigates the possible connection between inadequate PPE supplies and the prevalence of COVID-19 cases. Finally, the study used the COVID-19 infection rate variable to quantify the number of confirmed cases per 1,000 individuals, providing a standardized measure of the disease's spread. The COVID-19 cases variable also encapsulated the total cases recorded within each organization.

Table 1

Summary and Definition of Study Variables

Variables	Defined.
Census Region (Census region based on state)	1 = Northeast, 2 = Midwest, 3 = South 4 = West
Profit/Non-profit (Ownership type)	0 = Non-profit, 1 = Government, 2 = Profit
Infection Control Practices (ICPs)	0 = No, 1 = Yes
Size (Size of the facility based on the number of beds)	1 = Small (4-25 beds), 2 = Medium (26-50 beds), 3 = Large (more than 50 beds)
PPE Shortage	0 = No, 1 = Yes
COVID-19 Infection Rate	COVID-19 infection rate (number of infected cases per 1,000 people)
COVID-19 Cases	Residents' Total Confirmed COVID-19

The study performed the frequency distribution of the categorical variables. 18.2% (2,774) of the organizations were in the Northeast, 32.7% (4,989) in the Midwest, 33.7% (5,147) in the South, and 15.4% (2,346) in the West. There were 3,553 non-profit organizations (23.2%), 960 governments (6.3%), and 10,785 profit-based organizations (70.5%). Of the organizations surveyed, 36.4% (5,517) did not implement ICPs, while 63.6% (9,644) actively employed ICPs. Additionally, a breakdown of organizational size revealed that 2% (301 organizations) were classified as small, 12% (1,836 organizations) as medium, and the majority, 86.0% (13,161 organizations), as large entities. Furthermore, an overwhelming 99.5% (13,230 organizations) reported no shortages in PPE, underscoring their effective supply chain management. However, a small subset, comprising 0.5% (64 organizations), faced challenges related to PPE shortages.

Table 2

Frequency Distribution of Characteristics of RCCs

	Frequency	Percent
Census Region		
(Census region based on state)		
Northeast	2,774	18.20%
Midwest	4,989	32.70%
South	5,147	33.70%
West	2,346	15.40%
Profit/Non-profit (Ownership type)		
Non-profit	3,553	23.20%
Government	960	6.30%
Profit	10,785	70.50%
ICPs		
No	5,517	36.40%
Yes	9,644	63.60%
Size (Size of the facility based on the number of beds)		
Small	301	2.00%
Medium	1,836	12.00%
Large	13,161	86.00%
PPE Shortage		
No	13,230	99.50%

Yes	64	0.50%

Descriptive statistics of COVID-19 infection rates and cases were included in Table 3. The mean COVID-19 infection rate was 548.64 at a range of 0 – 44,000 and SD = 623.80. In addition, the mean number of COVID-19 cases was 370.05 at a range of 0 – 379 and SD = 34.69.

Table 3

Minimum, Maximum, Mean, and Std. Deviation of COVID-19 Infection Rates and Cases

	Minimum	Maximum	Mean	Std. Deviation
COVID-19 Infection Rate	0.00	44,000.00	548.63	623.79
COVID-19 Cases	0.00	379	370.05	34.68

Assumptions

For the successful application of ANOVA, it is crucial that the dependent variable exhibits approximate normal distribution. Normal variables should possess skewness and kurtosis values between -2 and +2. However, upon examination in the current study, the skewness and kurtosis of the dependent variables deviated from this optimal range. Consequently, this study used a rank transformation to rectify this non-normality to convert the non-normal variables into a more normal distribution. Using a rank transformation, the researcher replaced each value with its rank in ascending order.

Furthermore, another essential assumption for ANOVA is the homogeneity of variances across groups. The Levene test was used to assess the assumption, and for most variables, the p-value exceeded the significance threshold of 0.05. As a result, the assumption of homogeneity of variances was not upheld. The researcher adopted a strategy to address this issue by transforming the variables that did not meet the homogeneity of variances assumption.

Hypothesis Testing

H_1. There are statistically significant (*p value* ≤ 0.05) differences in the adoption of ICPs in reducing COVID-19 cases in RCCs.

Using a one-way ANOVA, the analysis examined if there are statistically significant differences in the adoption of ICPs in reducing COVID-19 cases and infection rates in RCCs (Table 4). This one-way ANOVA reveals significant variation between the groups, as evidenced by the difference in the Sum of Squares within and between groups. The statistically significant level is remarkably high, with an F-statistic of 239.36 and a *p-value* < 0.05. This outcome underscores the statistically significant differences in normalized COVID-19 Infection rates between the groups, further affirmed by the differences in group means. More specifically, the organizations with ICPs (514.66 ± 700.90) had lower COVID-19 infection rates than those without ICPs (615.83 ± 451.88). One-way ANOVA affirms the statistically significant differences in the adoption of ICPs in reducing COVID-19 infection rates.

Conversely, examining the within-group variation, signified by the larger Sum of Squares within Groups compared to the Between Groups Sum of Squares, indicates variation within the groups. Notably, the F-statistic (368.72) is very high, and the *p-value* < 0.05. The result shows the statistically significant differences in normalized COVID-19 Cases across groups, as indicated by the disparities in group means. Organizations with ICPs (33.51 ± 33.46) had lower COVID-19 cases than those without ICPs (43.88 ± 35.76). The outcome presents the statistically significant differences in the adoption of ICPs in reducing COVID-19 cases. Therefore, the null hypothesis is rejected.

Table 4

One-Way ANOVA: Differences in Normalized COVID-19 Infection Rates and Cases Based on ICPs

		Sum of Squares	df	Mean Square	F	Sig.
Normalized COVID-19 Infection Rate	Between Groups	34,49,591,172.15	1	3,449,591,172.150	239.36	<0.05**
	Within Groups	189,855,948,745.35	13,174	14,411,412.536		
	Total	193,305,539,917.50	13,175			
Normalized COVID-19 Cases	Between Groups	5,194,377,463.73	1	5,194,377,463.732	368.72	<0.05**
	Within Groups	184,487,501,657.62	13,096	14,087,316.865		
	Total	189,681,879,121.35	13,097			

**denotes statistical significance at the p-value of 0.05.

H_2. There are statistically significant ($p \leq 0.05$) differences between for-profit and nonprofit RCCs' ICPs, PPE shortages, and COVID-19 cases.

The study examined the differences in COVID-19 cases based on profit/nonprofit and PPE shortages by employing a two-way ANOVA. Complete model significance is evaluated across all independent variables in the Corrected Model. This two-way ANOVA reveals that the model is significant (*p-value* < 0.05), indicating that at least one of the independent variables, such as profit/non-profit has a statistically significant impact on the dependent variable (COVID-19 cases). The calculated Partial Eta Squared value of 0.03 adequately explains around 3% of the observed variance in COVID-19 cases. Intercept is the minimum number of COVID-19 cases when all PPE shortages and profit/nonprofit variables are zero. The statistical significance of the Intercept is bolstered by an associated p-value < 0.001. There was a statistically significant difference in COVID-19 cases based on profit/nonprofit [F (2, 13068) = 8.87, *p value*< 0.001]. More specifically, the profit organizations (40.73±35.50) had higher COVID-19 cases than the nonprofit organizations (28.08±30.03). There was a difference but not statistically significant in

COVID-19 cases based on PPE shortages p> 0.05 [F (1, 13068) = 3.63, *p value*= 0.057]. There was no statistically significant interaction between the effects of profit-nonprofit and PPE shortages on COVID-19 cases p> 0.05 [F (1, 13068) =0.19, *p value*=0.66].

Table 5

Two-Way ANOVA – Differences in Normalized COVID-19 Cases Based on Profit/Nonprofit and PPE Shortages

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6,411,177,558.10	4	1,602,794,389.52	114.32	<0.05**	0.03
Intercept	2,439,173,743.31	1	2,439,173,743.31	173.98	<0.05**	0.01
Profit/Nonprofit	248,810,100.98	2	124,405,050.49	8.87	<0.05**	0.00
PPE shortages	50,990,563.21	1	50,990,563.21	3.63	0.057	0.00
Profit/Nonprofit * PPE shortages	2,685,990.13	1	2,685,990.13	0.19	0.662	0.00
Error	183,208,214,552.44	13,068	14,019,606.25			
Total	762,847,147,586.25	13,073				
Corrected Total	189,619,392,110.54	13,072				

Note: * The interaction term denotes how Profit/Nonprofit and COVID-19 cases relate at different PPE shortage levels. **denotes statistical significance at the p-value of 0.05.

Two-way ANOVA was conducted to test the differences in COVID-19 infection rates. Corrected model significance is evaluated across all independent variables. This two-way ANOVA reveals that the model is significant (*p -value*< 0.05), indicating that at least one of the independent variables, such as profit/non-profit has a statistically significant impact on the dependent variable (COVID-19 infection rates). The calculated Partial Eta Squared value of 0.01

adequately explains around 1% of the observed variance in COVID-19 infection rates. Moreover, the Intercept, representing the minimum COVID-19 infection rate when PPE shortages and profit/non-profit variables are zero, boasts statistical significance affirmed by a *p-value* less than 0.05. There was a statistically significant difference in COVID-19 infection rates between profit and non-profit [F (2, 13189) = 5.85, *p value*=0.003].

More specifically, the profit organizations (587.76 ± 684.90) had higher COVID-19 infection rates than the non-profit organizations (456.25± 445.63). Yet, in contrast, there was no statistically significant difference in COVID-19 infection rates based on PPE shortages [F (1, 13189) = 1.70, *p value*=0.19]. Furthermore, there was no statistically significant interaction between the effects of profit-nonprofit and PPE shortages on COVID-19 infection rates [F (1, 13189) = 1.361, *p value*=0.24].

Table 6

Two-Way ANOVA – Differences in Normalized COVID-19 Infection Rates Based on Profit/Nonprofit and PPE Shortages

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	3,565,996,022.19	4	891,499,005.54	61.81	<0.05**	0.01
Intercept	2,322,573,596.34	1	2,322,573,596.34	161.03	<0.05**	0.01
Profit/Nonprofit	168,792,167.72	2	84,396,083.86	5.85	0.00**	0.00
PPE shortages	24,619,144.14	1	24,619,144.14	1.70	0.19	0.00
Profit/Nonprofit * PPE shortages	19,632,253.85	1	19,632,253.85	1.36	0.24	0.00
Error	190,226,160,021.71	13,189	14,423.091.97			
Total	777,428,499,962.00	13,194				
Corrected Total	193,792,156,043.90	13,193				

Note: * The interaction term denotes how Profit/Nonprofit and COVID-19 infection rates relate at different PPE shortage levels. **denotes statistical significance at the p-value of 0.05.

The study also used three-way ANOVA to determine if there are statistically significant differences between for-profit and nonprofit RCCs' ICPs, PPE shortages, and COVID-19 cases by performing a three-way ANOVA. This three-way ANOVA reveals the statistically significant difference in COVID-19 cases based on profit/nonprofit [F (2, 12951) = 8.87, *p value*< 0.05]. More specifically, the profit organizations (40.73±35.50) had higher COVID-19 cases than the nonprofit organizations (28.08±30.03).

In contrast, there was no statistically significant difference in COVID-19 cases based on PPE shortages, [F (1, 12951) = 2.17, *p value*=0.14] and on ICPs, [F (1, 12951) =0.02, *p* *value*=0.87]. Furthermore, there was no statistically significant interaction effect of profit-nonprofit, PPE shortages, and ICPs on COVID-19 cases [F (1, 12951) =0.35, *p value*=0.55].

According to "Partial Eta Squared," the model accounts for between 0.01 and 0.05 of the total variance, suggesting that the components and interactions explain a moderate quantity of variance. The complex correlations between profit/nonprofit status, PPE shortages, ICPs, and COVID-19 cases are displayed in Table 7's three-way ANOVA results. Organizational nature may affect infection rates, as evidenced by the considerable impact of Profit/Nonprofit status on COVID-19 Cases. Although several main effects and interactions were not statistically significant, this study helped shed light on how these factors influence COVID-19 outcomes.

Table 7

Three-Way ANOVA – Differences in Normalized COVID-19 Cases Based on Profit/Nonprofit, PPE Shortages, and ICPs

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	10,832,234,299.89	9	1,203,581,588.87	88.34	<0.05**	0.05
Intercept	2,197,436,395.55	1	2,197,436,395.55	161.28	<0.05**	0.01
Profit/Nonprofit	241,899,976.46	2	120,949,988.23	8.87	<0.05**	0.00
PPE shortages	29,591,633.43	1	29,591,633.43	2.17	0.14	0.00
ICPs	318,775.61	1	318,775.61	0.02	0.87	0.00
Profit/Nonprofit * PPE shortages	436,108.71	1	436,108.71	0.03	0.85	0.00
Profit/Nonprofit * ICPs	12,194,437.79	2	6,097,218.89	0.44	0.63	0.00
PPE shortages * ICPs	13,689,487.62	1	13,689,487.62	1.00	0.31	0.00
Profit/Nonprofit * PPE shortages * ICPs	4,853,194.06	1	4,853,194.06	0.35	0.55	0.00
Error	176,450,449,781.32	12,951	13,624,465.27			
Total	759,891,790,105.00	12,961				
Corrected Total	187,282,684,081.22	12,960				

Note: * The interaction term denotes how Profit/Nonprofit and COVID-19 cases relate at different PPE shortage levels and implementation of ICPs. **denotes statistical significance at the p-value of 0.05.

Three-way ANOVA was performed to investigate the prevalence of COVID-19 infection rates and the impact of profit/nonprofit status, personal protective equipment (PPE) shortages, and ICPs. The findings of this analysis shed light on the complex interplay between these variables and the infection rates. The three-way ANOVA reveals the statistically significant difference in COVID-19 infection rates based on profit/nonprofit [F (2, 13076) = 4.21, *p value*=0.01]. More specifically, the profit organizations (587.76 ± 684.90) had higher COVID-19 infection rates than the nonprofit organizations (456.25± 445.63). Therefore, Therefore, the null hypothesis is rejected.

In contrast, there was no statistically significant difference in COVID-19 infection rates based on PPE shortages [F (1, 13076) =0.55, *p value*=0.45] and ICPs, [F (1, 13076) =0.25, *p value*=0.61]. Furthermore, there was no statistically significant interaction between profit-nonprofit, PPE shortages, and ICPs on COVID-19 infection rates [F (1, 13076) = 1.65, *p value*=0.19].

Table 8

Three-Way ANOVA – Differences in Normalized COVID-19 Infection Rates Based on Profit/Nonprofit, PPE Shortages, and ICPs

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	6,608,844,507.113	9	734,316,056.34	51.84	<0.05**	0.03
Intercept	2,017,250,733.63	1	2,017,250,733.63	142.42	<0.05**	0.01
Profit/Nonprofit	119,253,242.26	2	59,626,621.13	4.21	0.01**	0.00
PPE shortages	7,909,070.42	1	7,909,070.42	.55	0.45	0.00
ICPs	3,544,504.34	1	3,544,504.34	.25	0.61	0.00
Profit/Nonprofit * PPE shortages	6,157,024.04	1	6,157,024.04	.43	0.51	0.00
Profit/Nonprofit * ICPs	75,811,293.38	2	37,905,646.69	2.67	0.06	0.00
PPE shortages * ICPs	29,586,820.21	1	29,586,820.21	2.08	0.14	0.00
Profit/Nonprofit * PPE shortages * ICPs	23,402,508.84	1	23,402,508.84	1.65	0.19	0.00
Error	185,201,075,903.54	13,076	14,163,434.98			
Total	774,323,045,202.75	13,086				
Corrected Total	191,809,920,410.66	13,085				

Note: * The interaction term denotes how Profit/Nonprofit and COVID-19 infection rates relate at different PPE shortage levels and implementation of ICPs. **denotes statistical significance at the p-value of 0.05.

H3. There are statistically significant (*p value* ≤ 0.05) differences in ICPs, PPE shortages, and COVID-19 cases between RCCs in different census regions.

Using one-way ANOVAs, the researcher examined the differences in COVID-19 cases and infection rates based on census regions. This one-way ANOVA reveals the statistically significant difference in COVID-19 infection rates based on census regions [F (3, 13244) = 31.47, *p value*< 0.05], with organizations in the South (573.41±526.40) reporting higher COVID-19 infection rates than those in the Northeast (485.93±458.95), the Midwest (565.48±793.17), and West (539.19±557.77). There was also a statistically significant difference in COVID-19 cases based on census regions [*F* (3, 13172) = 60.10, *p value*< 0.05], with organizations in the South (39.76±32.35) reporting more COVID-19 cases than in the Midwest (31.93±28.57) and West (34.86±35.65). Furthermore, the one-way ANOVA shows statistically significant variations in the means of the variables across areas for both the normalized COVID-19 infection rates and cases *(p value*< 0.05).

Table 9

One-Way ANOVA: Differences in Normalized COVID-19 Infection Rates and Cases Based on Census Regions

		Sum of Squares	df	Mean Square	F	Sig.
Normalized COVID-19 Infection Rate	Between Groups	1,374,439,884.97	3	458,146,628.32	31.47	<0.05**
	Within Groups	192,793,363,418.09	13,244	14,557,034.38		
	Total	194,167,803,303.07	13,247			
Normalized COVID-19 Cases	Between Groups	2,578,830,110.90	3	859,610,036.96	60.10	<0.05**
	Within Groups	188,392,347,683.49	13,172	14,302,486.15		
	Total	190,971,177,794.40	13,175			

**denotes statistical significance at the p-value of 0.05.

Four-way ANOVA was used to determine if there are statistically significant differences in ICPs, PPE shortages, and COVID-19 cases between RCCs in different census regions. The result shows no statistically significant difference in COVID-19 cases based on census regions [F (3, 12892) = 1.29, *p value*=0.27]. Furthermore, there was no statistically significant difference in COVID-19 cases based on PPE shortages [F (1, 12892) = 1.66, *p* value=0.19] and ICPs, [F (1, 12892) =0.07, *p value*=0.78]. Therefore, the researcher failed to accept the null hypothesis. In contrast, there was a statistically significant difference in COVID-19 cases based on profit/nonprofit [F (2, 12892) = 6.81, *p value*< 0.05]. More specifically, the profit organizations (40.73±35.50) had higher COVID-19 cases than the nonprofit organizations (28.08±30.03).

Table 10

Four-Way ANOVA – Differences in Normalized COVID-19 Cases Based on Region, Profit/Nonprofit, PPE Shortages, and ICPs

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	14,382,973,337.88	32	449,467,916.80	33.74	<0.05**	0.07
Intercept	,705,622,681.14	1	2,705,622,681.14	203.11	<0.05**	0.01
Region	51,690,496.81	3	17,230,165.60	1.29	0.27	0.00
Profit/Nonprofit	181,638,667.11	2	90,819,333.55	6.81	0.00**	0.00
PPE shortages	22,130,474.38	1	22,130,474.38	1.66	0.19	0.00
ICPs	1,028,118.55	1	1,028,118.55	0.07	0.78	0.00
Region* Profit/Nonprofit	788,462,276.66	6	131,410,379.44	9.86	<0.05**	0.00
Region * PPE shortages	1,747,527.64	3	582,509.21	0.04	0.98	0.00
Region * ICPs	33,913,573.06	3	11,304,524.35	0.84	0.46	0.00
Profit/Nonprofit * PPE shortages	142,689.43	1	142,689.43	0.01	0.91	0.00
Profit/Nonprofit * ICPs	7,806,109.47	2	3,903,054.73	0.29	0.74	0.00
PPE shortages * ICPs	17,665,844.29	1	17,665,844.29	1.32	0.24	0.00
Region * Profit/Nonprofit * PPE shortages	0.00	0	.	.		0.00

Region * Profit/Nonprofit * ICPs	117,037,647.17	6	19,506,274.53	1.46	0.18	0.00
Region * PPE shortages * ICPs	3,327,769.76	2	1,663,884.88	0.12	0.88	0.00
Profit/Nonprofit * PPE shortages * ICPs	7,743,517.99	1	7,743,517.99	0.58	0.44	0.00
Region * Profit/Nonprofit * PPE shortages * ICPs	0.00	0	.	.	.	0.00
Error	171,726,688,060.22	12,892	13,320,407.07			
Total	759,484,708,453.75	12,925				
Corrected Total	186,109,661,398.10	12,924				

Note: * The interaction term denotes how census region and COVID-19 cases relate at different PPE shortage levels, implementation of ICPs, and profit-nonprofit status of organization. **denotes statistical significance at the p-value of 0.05.

A four-way ANOVA was performed to explore the interplay between multiple factors and their influence on COVID-19 infection rates. The result reveals potential interactions and associations between these variables. This four-way ANOVA also shows the statistically significant difference in COVID-19 infection rates based on profit/nonprofit [F (2, 13018) = 7.636, *p value*< 0.05]. More specifically, the profit organizations (587.76 ± 684.90) had higher COVID-19 infection rates than the nonprofit organizations (456.25± 445.63).

In contrast, there was no statistically significant difference in COVID-19 infection rates based on PPE shortages [F (1, 13018) =0.58, *p value*=0.44] and census regions [F (3, 13018) =0.37, *p value*=0.77]. Furthermore, there was no statistically significant difference in COVID-19 infection rates based on ICPs, [F (1, 13018) =0.00, *p value*=0.97].

Table 11

Four-Way ANOVA – Differences in Normalized COVID-19 Infection Rates Based on Region, Profit/Nonprofit, PPE Shortages, and ICPs

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	9,358,022,628.25	32	292,438,207.13	20.99	<0.05**	0.04
Intercept	2,453,202,112.43	1	2,453,202,112.43	176.13	<0.05**	0.01
Region	15,739,775.28	3	5,246,591.76	0.37	0.77	0.00
Profit/Nonprofit	212,716,940.33	2	106,358,470.16	7.63	<0.05**	0.00
PPE shortages	8,082,700.79	1	8,082,700.79	0.58	0.44	0.00
ICPs	17,423.55	1	17,423.55	0.00	0.97	0.00
Region * Profit/Nonprofit	599,980,426.94	6	99,996,737.82	7.18	<0.05**	0.00
Region * PPE shortages	4,070,969.71	3	1,356,989.90	0.09	0.96	0.00
Region * ICPs	21,587,660.06	3	7,195,886.68	0.51	0.67	0.00
Profit/Nonprofit * PPE shortages	1,928,737.58	1	1,928,737.58	0.13	0.71	0.00
Profit/Nonprofit * ICPs	30,954,498.50	2	15,477,249.25	1.11	0.32	0.00
PPE shortages * ICPs	17,945,776.90	1	17,945,776.90	1.28	0.25	0.00
Region * Profit/Nonprofit * PPE shortages	0.00	0	.	.	.	0.00
Region * Profit/Nonprofit * ICPs	109,636,475.21	6	18,272,745.86	1.31	0.24	0.00

Region * PPE shortages * ICPs	386,641.53	2	193,320.76	0.01	0.98	0.00
Profit/Nonprofit * PPE shortages * ICPs	13,262,951.71	1	13,262,951.71	0.95	0.32	0.00
Region * Profit/Nonprofit * PPE shortages * ICPs	0.00	0	.	.	.	0.00
Error	181,312,670,072.53	13,018	13,927,843.76			
Total	773,755,475,211.50	13,051				
Corrected Total	190,670,692,700.79	13,050				

Note: * The interaction term denotes how census region and COVID-19 infection rates relate at different PPE shortage levels, implementation of ICPs, and profit-nonprofit status of organization. **denotes statistical significance at the p-value of 0.05.

H_4. There are statistically significant ($p \leq 0.05$) differences between small-, medium-, and large-sized RCCs' ICPs, PPE shortages, and COVID-19 cases.

The study then examined the effect of the variable "size" on normalized COVID-19 infection rates and normalized COVID-19 cases using one-way ANOVA. The result provides valuable insight into prospective differences in infection rates and cases across various population sizes. One-way ANOVAs were conducted with the independent variable of size and the dependent variables of COVID-19 cases and infection rates. This one-way ANOVA shows the significant difference in COVID-19 infection rates based on size [$F (2, 13283) = 136.54$, *p value*< 0.05]. More specifically, large organizations (566.04± 629.66) had higher COVID-19 infection rates than medium (471.58 ± 598.98) and small organizations (284.13 ± 377.62).

Furthermore, there was a statistically significant difference in COVID-19 cases based on size [$F (2, 13212) = 1008.15$, *p value<0.05*]. More specifically, large organizations (41.39±

35.36) had higher COVID-19 cases than medium (12.99 ± 13.79) and small organizations (5.23± 10.54). Therefore, the researcher rejected the null hypothesis.

Table 12

One-Way ANOVA – Differences in Normalized COVID-19 Infection Rates and Cases Based on Size

		Sum of Squares	df	Mean Square	F	Sig.
Normalized COVID-19 Infection Rate	Between Groups	3,935,692,005.92	2	1,967,846,002.96	136.54	<0.05**
	Within Groups	191,424,412,454.57	13,283	14,411,233.34		
	Total	195,360,104,460.50	13,285			
Normalized COVID-19 Cases	Between Groups	25,447,984,636.34	2	12,723,992,318.17	1008.15	0.00**
	Within Groups	166,749,677,088.65	13,212	12,621,077.58		
	Total	192,197,661,725.00	13214			

The five-way ANOVA was used to examine if there are statistically significant differences between small-, medium-, and large-sized RCCs' ICPs, PPE shortages, and COVID-19 cases. The result indicates the statistically significant difference between the COVID-19 cases based on size [F (2, 12846) = 198.68, *p value*< 0.001]. More specifically, large organizations had more COVID-19 cases (41.39± 35.36) than medium and minor organizations (12.99 ± 13.79). Therefore, Therefore, the null hypothesis is rejected. In contrast, there was no statistically significant difference between COVID-19 cases based on census regions [F (3, 12846) = 0.83, *p value*= 0.47], profit and nonprofit COVID-19 cases [F (2, 12846) = 1.69, *p value*= 0.18], PPE shortages [F (1, 12846) = 0.89, *p value*= 0.34] and ICPs [F (1, 12846) = 0.03, *p value*= 0.84].

This five-way ANOVA shows no statistically significant interaction effect of size, region, profit/nonprofit status, and ICPs on COVID-19 cases [F (10, 12846) =0.53, *p value*= 0.86].

Table 13

Five-Way ANOVA – Differences in COVID-19 Cases Based on Size, Region, Profit/Nonprofit, PPE Shortages, and ICPs

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	32,136,547,797.92	78	412,007,0230.05	34.37	0.00**	0.173
Intercept	2,293,176,360.42	1	2,293,176,360.42	191.32	<0.05**	0.015
Size	4,762,792,651.40	2	2,381,396,325.70	198.68	<0.05**	0.030
Region	30,063,951.70	3	10,021,317.23	0.83	0.47	0.00
Profit/Nonprofit	40,651,864.07	2	20,325,932.03	1.69	0.18	0.00
PPE shortages	10,668,919.57	1	10,668,919.57	0.89	0.34	0.00
ICPs	4343,46.74	1	4343,46.74	0.03	0.84	0.00
Size * Region	157,904,033.52	6	26,317,338.92	2.19	0.04	0.00
Size * Profit/Nonprofit	68,298,530.40	4	17,074,632.60	1.42	0.22	0.00
Size * PPE shortages	0.00	0	.	.	.	0.00
Size * ICPs	49,074,884.56	2	24,537,442.28	2.04	0.12	0.00
Region * Profit/Nonprofit	28,720,833.84	6	4,786,805.64	0.39	0.88	0.00
Region * PPE shortages	1,791,258.78	3	597,086.26	0.05	0.98	0.00
Region * ICPs	16,865,689.11	3	5,621,896.37	0.46	0.70	0.00
Profit/Nonprofit * PPE shortages	601,525.27	1	601,525.27	0.05	0.82	0.00
Profit/Nonprofit * ICPs	16,534,506.97	2	8,267,253.48	0.69	0.50	0.00

PPE shortages * ICPs	15,625,579.97	1	15,625,579.97	1.30	0.25	0.00
Size * Region * Profit/Nonprofit	13,5698,022.01	12	11,308,168.50	0.94	0.50	0.00
Size * Region * PPE shortages	0.00	0	.	.	.	0.00
Size * Region * ICPs	35,005,767.35	6	5,834,294.55	0.48	0.81	0.00
Size * Profit/Nonprofit * PPE shortages	0.00	0	.	.	.	0.00
Size * Profit/Nonprofit * ICPs	15,203,741.97	4	3,800,935.49	0.31	0.86	0.00
Size * PPE shortages * ICPs	0.00	0	.	.	.	0.00
Region * Profit/Nonprofit * PPE shortages	0.00	0	.	.	.	0.00
Region * Profit/Nonprofit * ICPs	95,516,154.52	6	15,919,359.08	1.32	0.24	0.00
Region * PPE shortages * ICPs	2,928,460.49	2	1,464,230.24	0.12	0.88	0.00
Profit/Nonprofit * PPE shortages * ICPs	7,009,297.76	1	7,009,297.76	0.58	0.44	0.00
Size * Region * Profit/Nonprofit * PPE shortages	0.00	0	.	.	.	0.00
Size * Region * Profit/Nonprofit * ICPs	64,283,495.24	10	6,428,349.52	0.53	0.86	0.00
Size * Region * PPE shortages * ICPs	0.00	0	.	.	.	0.00
Size * Profit/Nonprofit * PPE shortages * ICPs	0.00	0	.	.	.	0.00

Region * Profit/Nonprofit * PPE shortages * ICPs	0.00	0	.	.	.	0.00
Size * Region * Profit/Nonprofit * PPE shortages * ICPs	0.00	0	.	.	.	0.00
Error	153,973,113,600.18	12,846	11,986,074.54			
Total	759,484,708,453.75	12,925				
Corrected Total	186,109,661,398.10	12,924				

Note: * The interaction term denotes how size of the organization and COVID-19 cases relate at different PPE shortage levels, implementation of ICPs, profit-nonprofit status of organization, and census region. **denotes statistical significance at the p-value of 0.05.

The study also investigated the impact of several categorical variables on COVID-19 infection rates using a five-way ANOVA. The result highlights the complexity of the factors affecting COVID-19 infection rates. In contrast to "size," which has a statistically significant impact, "region" and "PPE shortages" are both relatively unimportant. Interactions exemplify the complexity of the interplay between the many factors that influence infection rates. This five-way ANOVA reveals that COVID-19 infection rates varied significantly based on size [F (2, 12972) = 16.68, *p value*< 0.001]. More specifically, large organizations had higher COVID-19 infection rates (566.04 629.66) than medium and minor organizations (471.58 598.98; 284.13 376.62).

In contrast, there were no statistically significant differences in COVID-19 infection rates based on census regions [F (3, 12972) =0.86, *p value*=0.46], profit and non-profit organizations [F (2, 12972) = 2.83, *p value*=0.059] personal protective equipment [F (1, 12972) =0.39, *p value*=0.52], and ICP [F (1, 12972) =0.70, *p value*=0.40]. Furthermore, this five-way ANOVA reveals no statistically significant interaction effect of region, profit/non-profit status, and ICPs on COVID-19 infection rates [F (10, 12972) = 1.54, *p value*=0.11].

Table 14

Five-Way ANOVA – Differences in Normalized COVID-19 Infection Rates Based on Size, Region, Profit/Nonprofit, PPE Shortages, and ICPs

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	12,318,034,299.52	78	157,923,516.66	11.48	<0.05**	0.065
Intercept	3,306,688,788.86	1	3,306,688,788.86	240.50	<0.05**	0.018
Size	458,769,147.60	2	229,384,573.80	16.68	<0.05**	0.00
Region	35,590,974.14	3	11,863,658.04	0.86	0.46	0.00
Profit/Nonprofit	77,962,135.43	2	38,981,067.71	2.83	0.05	0.00
PPE shortages	5,453,996.47	1	5,453,996.47	0.39	0.52	0.00
ICPs	9,753,066.73	1	9,753,066.73	0.70	0.40	0.00
Size * Region	82,717,386.99	6	13,786,231.16	1.00	0.42	0.00
Size * Profit/Nonprofit	26,818,719.95	4	6,704,679.98	0.48	0.74	0.00
Size * PPE shortages	0.00	0	.	.		0.00
Size * ICPs	26,260,657.55	2	13,130,328.77	0.95	0.38	0.00
Region * Profit/Nonprofit	141,097,113.73	6	23,516,185.62	1.71	0.11	0.00
Region * PPE shortages	3,579,901.73	3	1,193,300.57	0.08	0.96	0.00
Region * ICPs	36,517,200.89	3	12,172,400.29	0.88	0.44	0.00
Profit/Nonprofit * PPE shortages	1,613,807.16	1	1,613,807.16	0.11	0.73	0.00
Profit/Nonprofit * ICPs	32,390,609.56	2	16,195,304.78	1.17	0.30	0.00

PPE shortages * ICPs	16,862,300.46	1	16,862,300.46	1.22	0.26	0.00
Size * Region * Profit/Nonprofit	340,029,658.53	12	28,335,804.87	2.06	0.01**	0.00
Size * Region * PPE shortages	0.00	0	.	.	.	0.00
Size * Region * ICPs	85,336,881.65	6	14,222,813.61	1.03	0.40	0.00
Size * Profit/Nonprofit * PPE shortages	.00	0	.	.	.	0.00
Size * Profit/Nonprofit * ICPs	68,829,815.45	4	17,207,453.86	1.25	0.28	0.00
Size * PPE shortages * ICPs	0.00	0	.	.	.	0.00
Region * Profit/Nonprofit * PPE shortages	0.00	0	.	.	.	0.00
Region * Profit/Nonprofit * ICPs	137,308,195.50	6	22,884,699.25	1.66	0.12	0.00
Region * PPE shortages * ICPs	562,602.16	2	281,301.08	0.02	0.98	0.00
Profit/Nonprofit * PPE shortages * ICPs	12,988,067.17	1	12,988,067.17	0.94	0.33	0.00
Size * Region * Profit/Nonprofit * PPE shortages	0.00	0	.	.	.	0.00
Size * Region * Profit/Nonprofit * ICPs	211,888,730.82	10	21,188,873.08	1.54	0.11	0.00
Size * Region * PPE shortages * ICPs	0.00	0	.	.	.	0.00
Size * Profit/Nonprofit * PPE shortages * ICPs	0.00	0	.	.	.	0.00
Region * Profit/Nonprofit * PPE shortages * ICPs	0.00	0	.	.	.	0.00

Size * Region * Profit/Nonprofit * PPE shortages * ICPs	0.00	0	.	.	.	0.00
Error	178,352,658,401.26	12,972	13,749,048.59			
Total	773,755,475,211.50	13,051				
Corrected Total	190,670,692,700.79	13,050				

Note: * The interaction term denotes how the size of the organization and COVID-19 infection rates relate at different PPE shortage levels, implementation of ICPs, the profit-nonprofit status of the organization, and census region. **denotes statistical significance.

CHAPTER FIVE: CONCLUSIONS

Overview

The study aimed to explore the differences of Infection Control Practice outcomes based on the characteristic of Residential Care Communities (RCCs). The research highlighted the need for nuanced approaches to ICPs, considering factors such as organization type and size while questioning the role of PPE shortages in COVID-19 transmission. This chapter will discuss the statistical analysis findings and the study implications associated with COVID-19 infection cases and rates within the RCCs setting. Furthermore, it will also present the limitations and recommendations for future research.

Discussion

Differences in Adopting ICPs in Reducing COVID-19 Cases in RCCs

The first hypothesis, H1, stated, “There are statistically significant (*p value* $\leqslant$ 0.05) differences in the adoption of ICPs in reducing COVID-19 cases in RCCs”. The study showed statistically significant differences in normalized COVID-19 infection rates and cases between the groups, whereby organizations with ICPs had lower COVID-19 infection rates and cases compared to those without ICPs. Thus, the results suggest that adopting ICPs can significantly reduce COVID-19 infection rates and cases in RCCs. The finding aligns with the conclusions of several other studies that emphasized the differences in COVID-19 based on ICPs in various healthcare settings (Abueg, 2020; Chin et al., 2020; Liu et al., 2020; Yombi et al., 2020). Specifically, Abueg (2020) found that organizations with an ICP had fewer infections and deaths by approximately 6%-8% than those without an ICP (*p-value* < 0.05). Chin et al. (2020), Liu et al. (2021), and Yombi et al. (2020) noted that ICPs could help detect potential cases and take appropriate precautions in tracking and mitigating the transmission of virus when ICPs were adopted (*p-value* < 0.05). Hunter et al. (2020) emphasized the importance of well-implemented ICPs in contributing to the overall success of infection control measures, particularly for the prompt identification of infected cases and subsequent actions of mitigation. Hunter et al. (2020) noted the significance of ICPs, which are comprehensive strategies and protocols designed to prevent and manage the spread of infections in healthcare settings and other environments. These programs encompass various practices, policies, and procedures to minimize the risk of infection transmission. ICPs' effectiveness directly affects the success of efforts to prevent and manage infectious diseases. Clear guidelines and consistent enforcement of protocols can enhance the effectiveness of ICPs in protecting both patients and healthcare staff, creating a safe environment that directly correlates with the success of infection management and prevention. Jen et al. (2021) and Mann et al. (2020) demonstrated that ICPs effectively managed COVID-19 cases in long-term care facilities by preventing their spread within healthcare settings and including strategies and protocols to ensure the safety of residents and staff (*p-value* < 0.05). Using ICPs resulted in high patient satisfaction, reduced exposure to the virus, and improved clinical outcomes (*p-value* < 0.05). Rowe et al.'s (2020) study also aligns with this study because it also reported that organizations that used ICPs witnessed a statistically significant decrease in COVID-19 cases compared to those that did not (*p-value* < 0.05).

Additionally, Yi et al. (2020) focused on evaluating the difference in the risk of viral transmission based on ICPs in assisted living facilities, where they found a significant difference in the risk of viral transmission based on ICPs (*p-value* < 0.05). Assisted living facilities with ICPs had less risk of viral transmission than those without ICPs (*p-value* < 0.05). Other recent studies, including those by Nuertey et al. (2021), Malik et al. (2022), and Farrell et al. (2021), also highlighted the decrease of COVID-19 cases and other infectious diseases such as

Tuberculosis based on ICPs (*p-value* < 0.05). Organizations with ICPs had less COVID-19 and infectious diseases such as Tuberculosis than those without ICPs (*p-value* < 0.05). Prioritizing staff and resident safety through ICPs reduce the risk of infection and fosters a sense of security and trust within the organization.

Despite the significance of ICPs in infection prevention and management, the implementation of ICPs can be challenging due to lack of resources and variability of guidelines among different facilities (Lynch et al., 2020). Concerns about lack of training on both healthcare providers and patients with telemedicine was deficient to perform necessary examinations, which can influence patient-provider relationship in delivering effective care (Ftouni et al., 2022). The consequences of poor infection control management, including poor training of infection control knowledge and unclear guidelines, can lead to an increase of risks to the patients and healthcare workers (Abubakar et al., 2022; Lynch et al., 2020). Ineffective infection control concerning poor management and adherence are likely contribute to adverse events of infection control, and possibly leading to increased spread of virus (Rowe et al., 2020). Identifying and addressing these key factors will ensure ICPs remain effective, responsive, and successful in preventing and controlling the spread of viruses (Rowe et al., 2020). CDC's virtual course of infection control and management reported effective in promoting the public health as leaners claimed to have increased knowledge and confidence in practicing the CDC COVID-19 healthcare ICP guidance for nursing homes (≥81%) (Penna et al., 2022).

Differences between For-Profit and Nonprofit Centers' ICPs, PPE Shortages, and COVID-19 Cases

The second hypothesis, H2, stated that there are statistically significant (*p-value* < 0.05) differences between for-profit and nonprofit RCCs' ICPs, PPE shortages, and COVID-19 cases.

The study investigated the differences in COVID-19 infection rates and cases based on an organization's ownership type (for-profit vs. nonprofit). The study findings revealed a significant difference in COVID-19 cases between for-profit and nonprofit organizations (*p-value* < 0.05). Specifically, the study found that for-profit organizations had more COVID-19 cases than nonprofit organizations. These findings align with previous studies conducted by Lu et al. (2021), McGregor and Harrinton (2020), Stall et al. (2020), and Liu (2020), which demonstrated that for-profit facilities had higher COVID-19 cases and deaths among residents than nonprofit organizations (*p-value* < 0.05). For instance, McGregor and Harrinton (2020) found that for-profit organizations had significantly lower LTC staffing levels, leading to more COVID-19 cases than nonprofit facilities (*p-value* < 0.05).

Ibrahim et al. (2021) presented a contradictory result that the highest case-fatality rates of COVID-19 were observed at facilities operated by non-profit providers (*p-value* < 0.05). In addition, Ryskina et al. (2021) found that for-profit facilities had a slightly fewer (0.8 staff cases per 100 beds) COVID-19 cases among staff compared with non-profit facilities. One of the possible reasons for the contradiction of results is that the latter studies are more comprehensive in examining multiple characteristics associated with infection outcomes, such as size of the facility and its geographical locations. Also, Konetzka et al. (2021) found that the ownership of the facilities is likely to have no associations in the outcome of COVID-19 infection and mortality, this might because the COVID-19 presented a novel problem requiring extensive study and adoptions to address the issue. These results may contribute to a more nuanced understanding of relationships between different factors in context of infection prevention and control, which might lead to more valuable insights in developing effective ICPs.

Moreover, the study did not report any statistically significant differences ($p > 0.05$) in COVID-19 infection rates and cases based on shortages in PPE. Despite the findings, it is essential to highlight the differences in COVID-19 rates and cases based on PPE shortages within RCCs. Stewart et al. (2020) reported differences in viral transmission based on PPE shortage, indicating that facilities using surgical masks were more likely to prevent the virus transmission when treating COVID-19-confirmed patients than organizations that did not use surgical masks (*p-value* < 0.05). John et al. (2017) emphasized the importance of consistent and proficient training in PPE utilization. Therefore, it is crucial to provide comprehensive training in PPE usage to ensure robust COVID-19 infection control.

Differences in ICPs, PPE Shortages, and COVID-19 Cases between Facilities in Different Census Regions

Hypothesis three stated, "There are statistically significant (*p-value* ⩽ 0.05) differences in ICPs, PPE shortages, and COVID-19 cases between RCCs in different census regions". There were significant differences in COVID-19 infection and case rates among organizations across different census regions (*p-value* < 0.05). Organizations in the South reported higher infection rates than those in the Northeast, Midwest, and West. Similarly, the South had a higher number of reported COVID-19 cases compared to the Midwest and West (*p-value* < 0.05). These results support previous studies that also found higher COVID-19 infection rates and death rates in the Southern regions compared to other areas (*p-value* < 0.05). Jackson et al. (2021) found more infected cases and death rates in the Southern regions than in Southwestern areas (*p-value* < 0.05). Similarly, Abrams et al. (2020) found higher infection rates and death rates in rural areas, such as the Southern regions, compared to urban regions (*p-value* < 0.05). The reasons for these differences are numerous and complex, often resulting from a combination of factors such as population density, travel, social behavior, governmental regulations, healthcare facilities, climate, socioeconomic conditions, pre-existing health issues, testing and reporting, public outlook, and migration trends (Jackson et al., 2021).

However, when census regions were considered with other independent variables such as organizational profit status, PPE shortages, and ICPs in four-way ANOVA, the significance of census regions became relatively diminished (*p-value* > 0.05). Specifically, when census regions were considered with other independent variables, there was no significant difference in COVID-19 infection rates and cases based on census regions (*p-value* > 0.05). The finding emphasizes the importance of understanding the interplay between regional influences and other contributing factors (organizational profit status, PPE shortages) to the transmission dynamics of COVID-19. Further exploration is necessary to understand the difference in COVID-19 spread based on the interconnection of seemingly unrelated variables. Future research should examine the disparities in COVID-19 infections based on geographical locations and specific regions' environmental and socioeconomic constituents to understand the intricate dynamics better. Examining the differences is important because the findings regarding geographical locations differ in ANOVA and four-way ANOVA.

As more studies were conducted to test the prevalence of geographic differences in infection outcomes and mortality, numerous researchers found that geographic region might not directly contribute to the outcomes of infection cases and rates, but the characteristics and factors associated with the geographic locations, including population density, local policy, climate, and poverty level (Thakur et al., 2021; McGowan & Bambra, 2022; Tan et al., 2020; Bambra et al., 2020). For instance, the study conducted in Massachusetts found that the mortality rate is 40% higher in cities and towns characterized by elevated poverty level (weighted average threshold for one person and two people are, $14,880 and $18,900, respectively) and higher percentage of populations of color during COVID-19 (Tan et al., 2020; US Census Bureau, 2022). Understanding these characteristics embedded in location variation is essential for promoting the targeted interventions.

Differences between Small, Medium, and Large-Sized Facilities' ICPs, PPE Shortages, and COVID-19 Cases and Death Rates among Patients in Residential Care Communities during COVID-19

Hypothesis four stated, “There are statistically significant ($p \leq 0.05$) differences between small-, medium-, and large-sized RCCs’ ICPs, PPE shortages, and COVID-19 cases. The size of the facility was found to be highly associated with the COVID-19 outbreak and infection rates (*p-value* < 0.05; Stall et al., 2020). Larger organizations, especially healthcare facilities, may accommodate more individuals, increasing human interactions, and elevating the risk of transmission (He et al., 2020). In other words, larger organizations (more than 50 beds) had higher COVID-19 infection cases and rates than smaller organizations (4-25 beds (*p-value* < 0.05). This study also indicated that there was a significant difference in COVID-19 infection rates based on the size of the organization (*p-value* < 0.05). The findings are consistent with prior studies that found increased COVID-19 cases in larger nursing homes with higher bed occupancy (He et al., 2020).

Bhadra et al. (2020) introduced another dimension to this discourse—spatial disparities. The authors posited that while the facility's overall size matters, there is a significant difference in COVID-19 spread due to the population's density within that space (*p-value* < 0.05). In other words, the risk escalates even if a facility is enormous if it houses a dense population. The danger in larger facilities is high by making denser populations result in closer interactions, reducing the physical distance between individuals because of the nature of the virus. Since COVID-19 spreads through respiratory droplets, more intimate interactions and reduced distances facilitate easier transmission. In addition to Bhadra et al.'s (2020) insights, McGarry et al. (2021) noted that larger nursing homes have higher COVID-19 cases than medium and small ones (*p-value* < 0.05) by having more communal areas, such as dining halls, lounges, or activity areas, where residents gather. The primary reason is that shared spaces in larger nursing homes are potential hotspots for transmission. On the other hand, Liljas et al. (2022) suggested that despite larger facilities having a higher number of transmissions, the risk of outbreak tends to be lower compared to smaller facilities due to the facility design and staff compartmentalization.

Connection to Systems Theory

The Systems Theory approach has proven valuable in shedding light on the difference in infection rates and cases based on input and ICPs. The findings showed a significant difference in COVID-19 infection rates and cases based on ICPs in RCCs (*p-value* < 0.05). By analyzing the difference in COVID-19 outcomes based on input and ICPs, RCCs may develop effective strategies to reduce infection rates. To successfully limit the spread of the virus, RCCs must adopt a cyclical approach of monitoring, evaluating, and adapting input and ICPs based on the feedback. The cyclical process helps to identify potential weaknesses and adapt to evolving challenges. Looking at RCC as a system helps to identify why infection outcome differs between RCCs based on the input, and the result of infection control practices (output) can determine the root cause of the differences and help to inform how process and input should be changed to improve the outcome. For example, this study found that for-profit organizations had higher COVID-19 infection rates and cases (output) than nonprofit organizations (*p-value* > 0.05), implying that the facility's profit status could have a significant impact on the adoption of ICPs and substantially influence the outcome of COVID-19 transmission. Moreover, the size of the facility (input) demonstrated a significant difference in COVID-19 rate outcomes among RCCs (*p-value* > 0.05). By further assessing the association between the size of the facility and ICPs, researchers can implement a more effective approach based on the feedback to improve healthcare prevention and disease management. The feedback on the facility level allows healthcare organizations to evaluate their deficiencies in preventive approaches, facilitating their preparedness for future outbreaks. In addition, effective communication of influential determinants and ICPs among stakeholders ensures a cohesive effort to reduce COVID-19 infection rates. RCCs must be proactive in iterating the strategies based on feedback and the changing nature of the challenge. With comprehensive and adaptive policies, RCCs can minimize COVID-19 spread and safeguard residents and the broader community. By championing the cause of quality care, RCCs can establish themselves as leaders in the healthcare industry. In addition, RCCs can earn the trust of the stakeholders and contribute to the collective effort in fighting the pandemic.

Furthermore, Systems Theory advocates for continuous improvement and adaptability within the healthcare system. The ability of prompt responses and holistic approach of Systems Theory enable healthcare workers and policymakers to swiftly adjust the guidelines and policies in responses to any emergency infectious responses. For instance, the characteristics of the RCCs are interconnected components, as each of the factors represents different aspects of the settings that might potentially associated with the ICPs, including profit status (organizational structure), size and geographical location (environmental factor), and PPE shortages (resources allocation). ICPs are not isolated interventions but interconnected components that help healthcare workers to understand and form more comprehensive strategies in handling different situations. This holistic approach can further reinforce the effectiveness of ICPs, as well as facilitate resources allocation within the healthcare system.

Overall, Systems Theory can facilitate healthcare organizations to develop, implement, and constantly improve their ICPs. The integration of Systems Theory from the perspective of infection control provides roadmaps for healthcare workers and policy makers to identify and recognize the intricate relationship between various factors, and lead to desire output of ICPs. System Theory also employs an input-process-output model that provides cyclical feedback that allows healthcare facilities to recognize their deficiencies by comparing the differences of output with various inputs. This holistic perspective of Systems Theory can enhance the ability of RCCs to respond and address complex infection control and management challenges.

Implications

Despite the extensive research on COVID-19 infection control practices, little has been written about the impact of the characteristics of the RCC on infection control outcomes. A gap existed in understanding the extent and interplay of environmental factors associated with the outcome of infection control practices. This study seeks to bridge the gap by contributing to understanding the differences in ICPs outcomes based on the characteristics of the RCC.

The study found that the profit status of the facility can significantly impact the outcome of infection control practices. This insight underscores the importance of considering financial and operational structure when designing and adopting ICPs in residential care communities. Policymakers, healthcare professionals, and facility managers should recognize the influence of profit status on infection control effectiveness and tailor interventions accordingly. Moreover, another significant result arising from this study is the substantial impact of the facility's size on the outcome of ICPs. Learning more about how size of the facility can affect the operational aspects and the management of shared space can offer valuable insights to RCCs and other long-term care facilities for the future pandemic. Policymakers, healthcare professionals, and facility managers should take into consideration of nuanced dynamic and unique challenges posed by varying size of the facility, designing and implementing tailored measures to enhance the ICP approaches within long-term care settings.

In addition to understanding the need for multiple ICPs to ensure adequate infection control, the study may enable RCCs to recognize that broad organizational and regional factors can influence the success of ICPs. Moreover, organizations may learn that RCCs of different sizes may have distinct characteristics that affect their ICP approach and residents' well-being. Furthermore, the holistic approach of Systems Theory, not only offers insights into the operational aspects of ICPs in residential care communities, but also paves the way for a broader understanding of the interconnected environmental factors influencing the overall success; healthcare facilities can leverage the approaches beyond the individual ICPs. For example, understanding the unique characteristics of the RCCs allows policymakers to tailor regulations that address the specific needs of the sector, and help in identifying potential risks associated within the context of RCCs. This information can also help policymakers to gain deeper insights into resources needs, facilitating more reasonable allocation of resources and the development of policies to support the efficiency and sustainability of the RCCs. Policies and regulations can be designed to prioritize the patients' needs and safety in order to promote patient-centered care.

Call for Policy Evolution

It is important to understand the complexity of infection control prevention and management within the long-term care setting. COVID-19 has made it clear that the residents of RCCs must be designated as a priority for infection control due to their vulnerability. As the result of this study indicated several potential factors associated with the outcome of infection control practices, actions can be taken to promote the effectiveness of ICPs via policies. The significance of adoption of ICPs implies that infection control and management are essential in protecting the safety of residents during the pandemic. The federal government should be in place to respond to future pandemic by integrating the best practices already developed and infection control preparedness experiences learned from previous ones. The federal fundings, regulations, and other supporting programs associated with RCCs require a comprehensive framework, ensuring the adaptability of infection control practices to the dynamic needs for the residents and healthcare providers. Yet, the variations of ICPs existed across the healthcare settings, resulting in discrepancies of infection control effectiveness and outcomes influenced by various factors. The federal agencies could learn or continue to invest in long-term facilities by examining different factors that might potentially impact the outcomes of ICPs. This approach advocates for primary prevention by determining the key factors that promote the effectiveness of ICPs and targeting vulnerable populations that might be harmed the most. Preventive solutions can further reinforce the policies which seek to provide clearer instructions and guidelines when helping healthcare organizations to make evidence-based decisions. These solutions can be achieved through efforts to identify and monitor influential components, set up surveillance system to maintain constant feedback, and design tailored program to address unique needs in long-term care settings.

The collaboration between federal, state, and local governments are crucial to improve the policy revisions in response to the ever-changing state of the pandemic (Kusumasari et al., 2022; Park & Chung, 2020). Public health measures in infection control can use evidence-based strategies by sharing information to provide better guidelines to local agencies based on their unique characteristics and needs. For example, the variation of infection outcome of ICPs associated with profit status of facilities should be emphasized to promote resources allocation and seek changes for reinforcement of the infection mitigations. Policies can be established to guide profit-driven facilities on how to scientifically prioritize resources among residents and healthcare providers.

There have been complaints among local policies over PPE shortage and resources allocation within healthcare facilities (Rubashkin et al., 2023; Unruh et al., 2021). PPE shortage occurred at early stage of COVID outbreak had put healthcare providers and patients in risk of transmission, as well as the healthcare facilities for taking the account for PPE allocations. These decisions were complicated by unequal distribution of PPE due to dramatic increase of PPE demands in all aspects. Despite prompt policy and guideline established by CDC for offering alternative options of medical use PPEs, such as KN95 mask as a replacement of N95, most healthcare providers were still facing challenges to reuse masks when providing the care (Unruh et al., 2021). Moreover, there remains a question on whether healthcare administrative teams have the expertise to make decisions on PPE distributions in order to reach the maximum protection among healthcare workers. Unclear guidelines from public health authorities during the early stage of the outbreak could have led to further disruptions and uncertainty in healthcare sectors. It is necessary to address the importance of policy change in response to the health crisis. The dynamic nature of novel virus necessitates adaptivity and effective policy measures to ensure the well-being of public and healthcare workers.

Limitations

External and Internal Validity

The study's limitations can significantly impact the research outcomes and the generalizability of its findings (Leedy and Ormrod, 2016). The regional focus on US RCC residents threatens external validity and limits the extent to which the study's results can be generalized beyond certain areas of the United States. Future researchers should diversify the participant pool by incorporating RCC residents from different countries to address this limitation and enhance external validity. A secondary limitation pertains to the demographic homogeneity of RCC residents, which can compromise external validity. Future studies should deliberately diversify the participant pool in terms of demographics to address this aspect of limited external validity.

Additionally, there can be selection bias, which challenges how RCC residents accurately reflect the broader population of residents in RCCs (Cooper & Schindler, 2014). The primary data source has limitations, as many RCCs abstained from the survey due to the labor shortage caused by the COVID-19 outbreak. Rigorous data management and scrutiny are crucial in pandemic research. In future studies, a general condition will be derived together with a procedure for deciding the odds ratio recoverability from biased data to remove selection bias. The potential regression threat can occur as a statistical phenomenon when statistical selection is biased (Vaishnavi & Kuechler, 2015). Researchers should omit extreme scores in future studies to remove the regression threat.

Evaluating the effectiveness of different ICPs was challenging due to limitations in the dataset. Most data consisted of one type of ICP, making it difficult to compare across a diverse range of ICPs. As a result, the researcher could not draw definitive conclusions about the superior effectiveness of one practice over another. Another complicated factor was introduced where patients could contract COVID-19 multiple times and recorded repeatedly within the dataset. The repetition potentially introduced bias and could skew the analytical results, making it challenging to arrive at accurate and meaningful conclusions regarding the effectiveness of ICPs.

Additionally, the study found a discrepancy in results between one-way ANOVA and factorial ANOVA. While the one-way ANOVA considers the effect of a single independent variable in isolation, the three-way ANOVA considers multiple independent variables and potential interactions. Confounding factors can influence the significance of the main effect, leading to a contradiction between the results. However, accounting for additional factors can provide a more complete picture of the real-world implications, requiring more comprehensive investigation and analysis.

Another limitation of this study is that it did not analyze the variation of the policies within the RCCs. Policy and guidelines are integral parts of implementation of the ICPs, which can significantly impact the adherence and outcome of the infection prevention and management in the healthcare sector. The importance of addressing the policy based on the characteristics and unique needs of residents and healthcare workers is essential in developing effective strategies to ensure the safety of public health and trust in healthcare system. Accounting for policy clarification and adherence can provide more robust infection control measures, coupled with consistent implementation of ICPs and monitoring are fundamental keys for the establishment of comprehensive and effective infection control frameworks.

Recommendations for Future Research

There are several recommendations for future research. First, future research should expand participant pools outside American borders to consider the multiple characteristics of age, ethnicity, and cultural influences well-captured worldwide. By embracing diversity, researchers can create a broader picture of how ICPs function in various circumstances. Researchers must use analytical approaches to assess the robustness of findings under varied circumstances, enhancing the trustworthiness of study findings.

Future research should improve the data quality used in research projects. Future research is urged to follow a more diversified path, considering the limitations presented by datasets centered on specific ICPs. The collection of data from a broader range of ICPs is also required, allowing for a thorough evaluation and comparison of the relative efficacy of various measures for reducing COVID-19 infection rates and cases. A resounding appeal is issued to use sophisticated data collection procedures to minimize the potential distortion caused by patients who repeatedly contract recurrent COVID-19 infections. These techniques attempt to preserve a comprehensive perspective of the infection history across RCC residents while precisely tracking distinct cases of COVID-19 infections. By removing the stress of repetition, researchers may extract more precise and complex insights from their data.

Policy Recommendation

In response to the ongoing and potential infectious threats, it is imperative to develop robust infection control policies to safeguard public health. Given the result this study, there are three policies recommended when facing the future pandemic:

Policy recommendation #1: During the emergency of pandemic, the federal and state administration need to drive both public and private industries for production of needed PPEs, including masks and gowns, and ensure those supplies are readily accessible for RCCs. While PPE is being widely recognized as an effective measure to prevent the spread of infectious viruses, the availability and proper usage are essential to maintain the effectiveness of PPEs (WHO, 2020; Mahmood et al., 2020). Despite the insignificant result presented by this study, Steward et al. (2020) emphasized the importance of adequate access and appropriate use of PPE for healthcare workers to safeguard their health and minimize the risk of nosocomial transmission, especially during the early stage of the pandemic with lack of preparedness within the healthcare settings Rubashkin et al., 2023; Unruh et al., 2021). The need for permanent and long-term policy that establishes adequate availability of PPEs would be essential to face the challenges for future outbreaks.

Policy recommendation #2: RCCs must be designated as priority facilities by Department of Health during the pandemic; the RCCs must be funded appropriately so the frontline healthcare providers can be safely protected and continue to provide necessary care to the older adult patients who require urgent or routine care. As previous studies have consistently highlighted the vulnerability state of older adult patients with increased risk to infectious diseases, RCCs (majorly comprised of older adult patients) must be considered as priority facilities with heightened attention. It is imperative for these facilities to receive adequate resources for planning and implementing ICPs, such as telehealth. This will necessitate a considerable allocation of resources towards upgrading infrastructure for supporting the implementation of ICPs and ensure the delivery of essential cares.

Policy Recommendation #3: The CDC, along with state and local healthcare government need to establish a new protocol for the communication reinforcement on collecting most updated and emerging information on infectious diseases. Comprehensive and effective infection control approaches require timely information on various aspects as indicated by this study. The feedback regarding the constantly changing landscape of the virus can enable healthcare administration teams to conduct thorough analysis with the most updated information and react in a timely manner. The reinforced communication channel between local and upper healthcare bodies facilitates seamless communication, including the provision of unique characteristics of each local facility. This allows healthcare government for a more comprehensive understanding of the specific needs and challenges faced by individual facilities, facilitating tailored support and ICPs in mitigating the infectious threats. In addition, enhanced communication fosters collaboration and administrative efforts, consequently optimizing the responses efficiency and resources allocations between different levels of government bodies.

Summary

The study aimed to evaluate the difference in COVID-19 outcomes based on the characteristics of RCCs (ICPs, PPE shortages, ownership type (for-profit vs. nonprofit), census regions, and RCC size). The adoption of ICPs is essential for healthcare facilities to provide preventive approaches with the aim to decrease the transmission rate of COVID-19 among older adult patients and healthcare professionals within RCCs. Studying the contributing factors to the overall success of ICPs facilitate the adherence and effectiveness of preventive approaches and preparedness for the future outbreak. By doing so, the study offers insights into COVID-19 outcomes in RCCs. The study emphasizes the significance of ICPs, the intricate nature of PPE shortages, and the necessity of custom-tailored strategies based on ownership type and RCC census region, as well as the size of the facility. This study employed ANOVA to answer the research questions. The findings yielded some insights consistent with previous research, while others diverged from prior studies.

One of the study's findings was that organizations with ICPs reported a lower incidence of COVID-19 infections than those without ICPs. However, the result contradicted the factorial ANOVA when considering other independent variables. Future studies should explore ICPs from a more diverse perspective to gain a deeper understanding. The research found no significant variation in COVID-19 infection rates concerning PPE shortages, which contradicts the findings of previous studies. The complexity of COVID-19 transmission based on PPE availability underscores the need for further research to clarify the discrepancy. The study also observed that for-profit organizations and larger entities tended to report higher COVID-19 rates compared to nonprofit and smaller counterparts. The finding highlights the need for tailored ICP strategies for different types and sizes of organizations. However, the research did not identify significant differences in COVID-19 cases across other census regions, indicating that region-specific dynamics may not be the sole determinants of infection rates. In conclusion, this study shed light on the characteristics of RCCs and their impacts on the COVID-19 infection outcomes. While the result of this study reported lower cases with ICPs with other environmental factors, it is important to acknowledge the discrepancies found through factorial ANOVA. The need for future studies should continue to explore the ICPs in the context of diverse perspectives and highlight the importance of gaining a more comprehensive understanding of their effectiveness. More efforts are also expected to continue navigate the challenges posed by the pandemic and ensure preparedness for future potential outbreaks.

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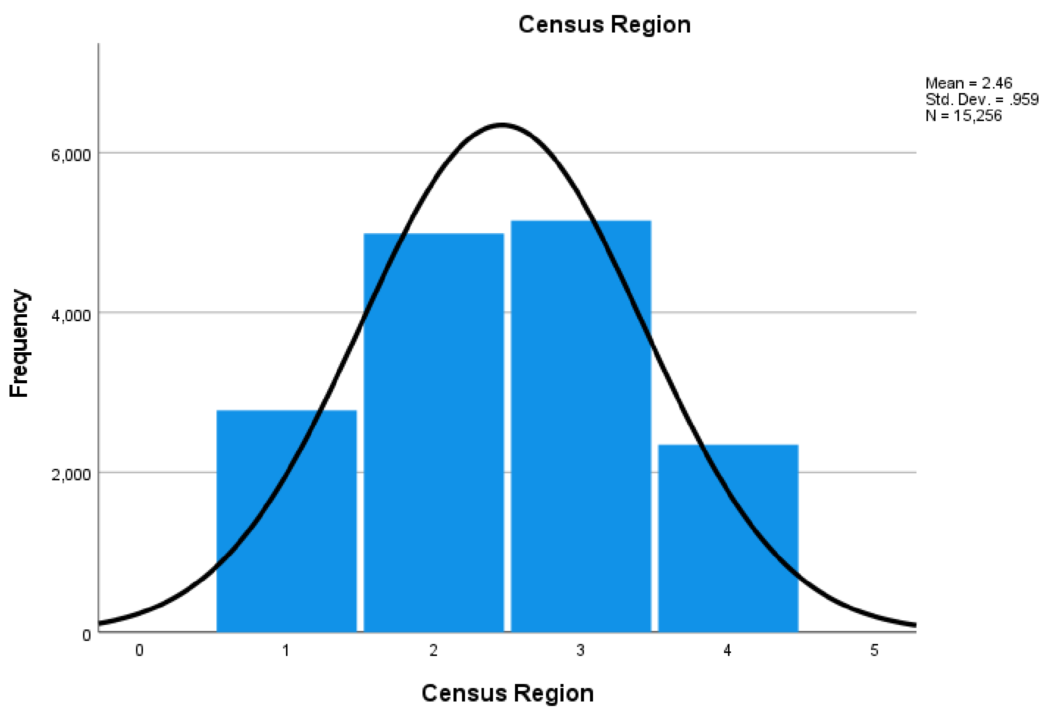
Appendix A: Graph and Table

Bar Graphs

Figure 1

A Bar Graph on Census Regions and their Frequency

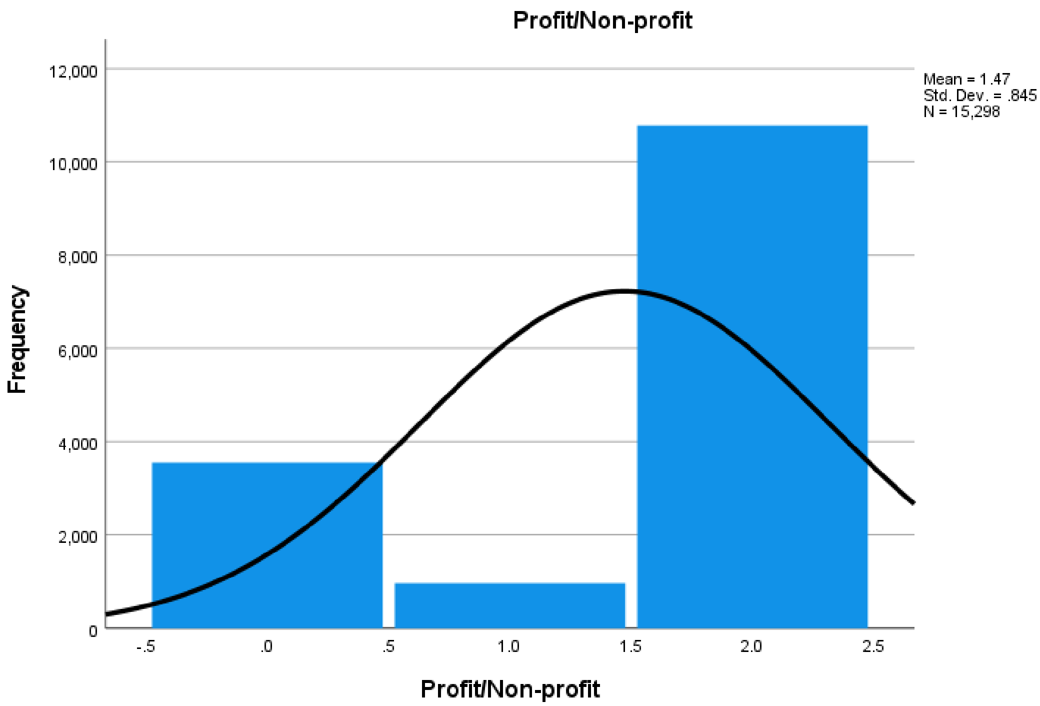


Notes. 1=Northeast, 2=Midwest, 3=South, and 4=West

Figure 1 shows the numbers and distribution of various RCCs in different geographic locations, including Northeast, Midwest, South, and West. South has the biggest number of RCCs, followed by the Midwest, Northeast, and finally, west region plotted from the census region binary. Differences in infection control practices, PPE shortages, and COVID-19 cases between facilities in different census regions are shown to be significant.

Figure 2

A Bar Graph on Profit/Non-Profit RCCs and their Frequencies

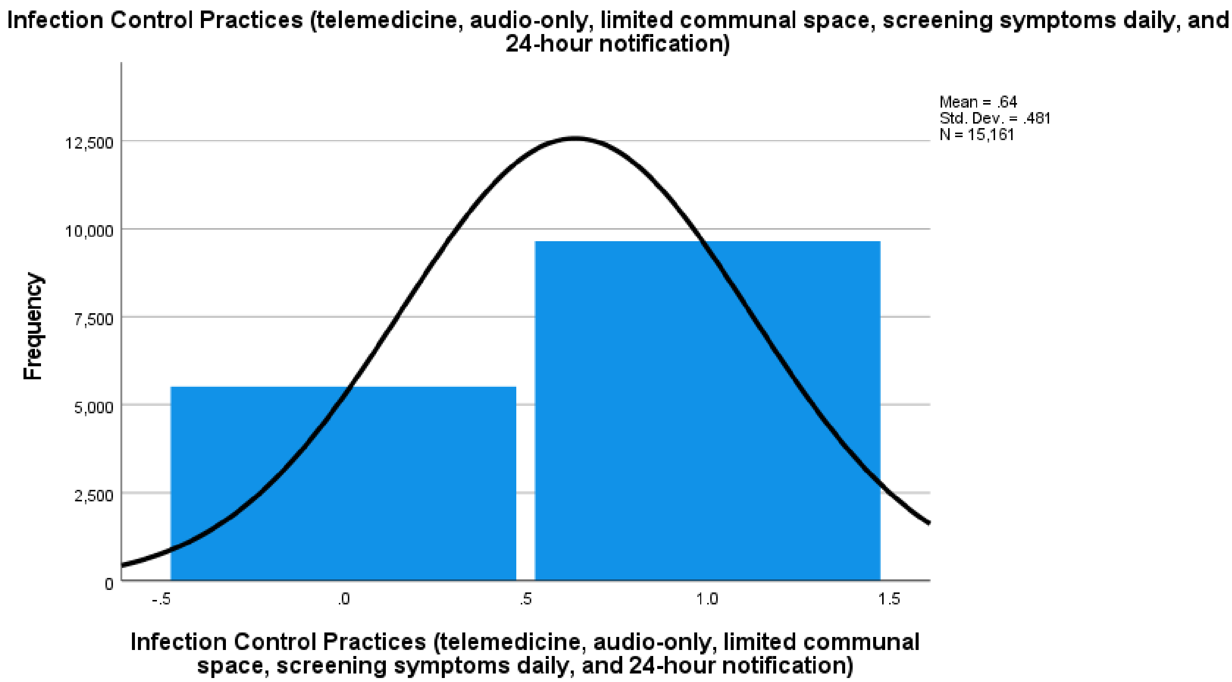


0=Non-profit, 1=Government, 2=Profit

Figure 2 shows the prevalence of various RCCs operating as for-profit, non-profit, or governmental entities. Most RCCs are for-profit, followed by non-profit, and lastly, government. The association between the characteristics of residential care communities and the quality of care provided to residents differs in the various organizational characteristics and COVID numbers.

Figure 3

A Bar Graph on ICPs and their Frequencies

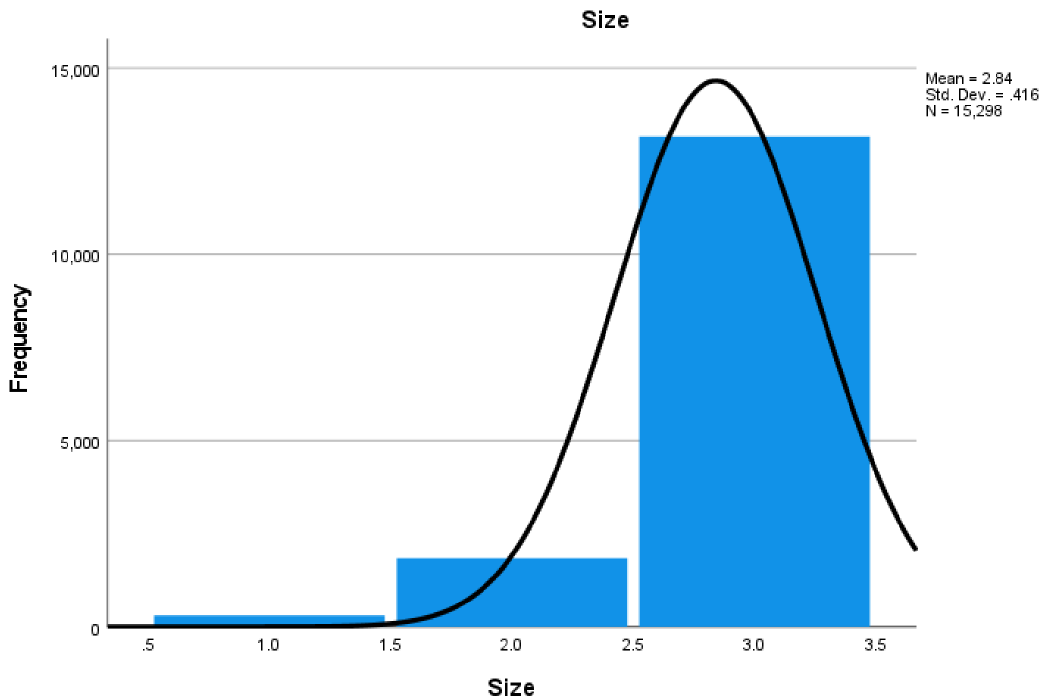


Notes. 0=No, 1=Yes.

Figure 3 shows the distribution of various infection control practices ICPs binary such as [Telemedicine (1=yes, 0=no), Audio-only (1=yes, 0=no)].

Figure 4

A Bar Graph on RCCs Various Sizes and their Frequency

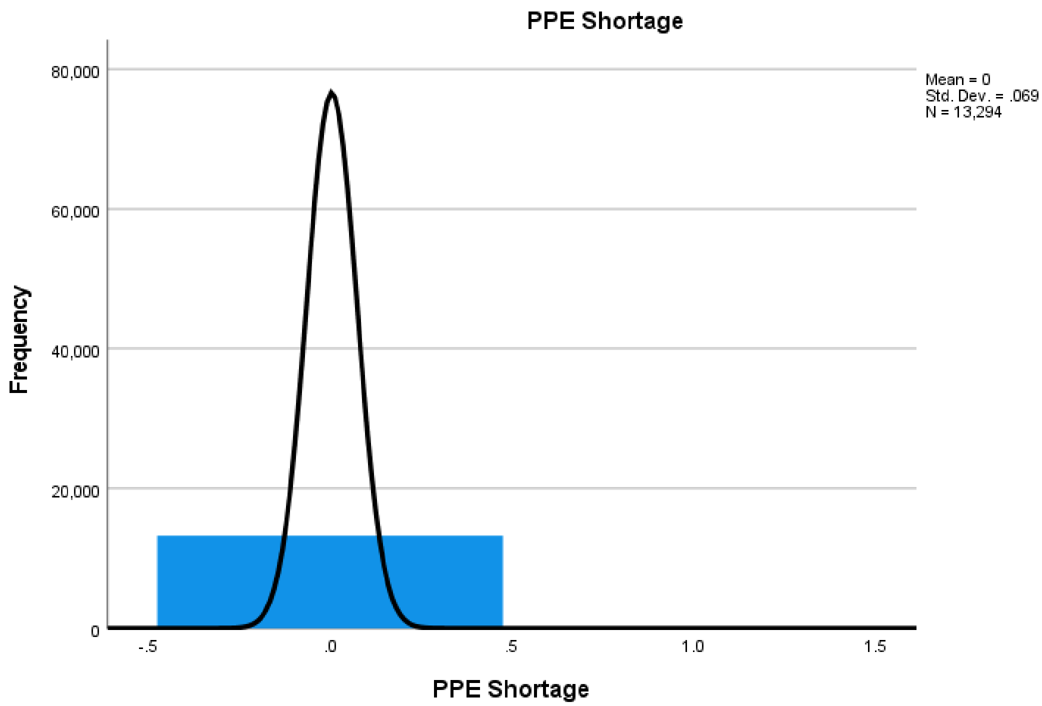


Notes. 1=Small, 2=Medium, 3=Large

Figure 4 shows the COVID-19 number of various sizes of RCCs. It portrays differences in resident outcomes, such as COVID infection cases and rates, between residents of small, medium, and large residential care communities in the United States in 2020-2021. The relation between the size of the RCCs and COVID-19 outcomes is directly proportional. It shows that community size is a significant factor in determining resident outcomes.

Figure 5

A Bar Graph on PPEs Shortage in Various RCCs



Notes. O=No, 1=Yes

Figure 5 represents the PPE shortage binary, where a tiny portion of the shortage was prevalent across all RCCs.

Table 15

Homogeneity of Variances - ICPs

		Levene Statistic	df1	df2	Sig.
COVID-19 Cases	Based on Mean	18.77	1	13,096	<0.001**
	Based on Median	19.84	1	13,096	<0.001**
	Based on Median and with adjusted df	19.84	1	13,083.13	<0.001**
	Based on trimmed mean	19.58	1	13,096	<0.001**
COVID-19 Infection Rate	Based on Mean	3.85	1	13,174	0.05
	Based on Median	2.16	1	13,174	0.14
	Based on Median and with adjusted df	2.16	1	10,363.88	0.14
	Based on trimmed mean	2.67	1	13,174	0.10

Table 16

Homogeneity of Variances - Profit/Non-profit

		Levene Statistic	df1	df2	Sig.
COVID-19 Cases	Based on Mean	51.84	2	13,212	<0.001**
	Based on Median	56.44	2	13,212	<0.001**
	Based on Median and with adjusted df	56.44	2	13,098.00	<0.001**
	Based on trimmed mean	55.25	2	13,212	<0.001**
COVID-19 Infection Rate	Based on Mean	4.39	2	13,283	0.01**
	Based on Median	6.88	2	13,283	0.00**
	Based on Median and with adjusted df	6.88	2	11,230.28	0.00**
	Based on trimmed mean	5.48	2	13,283	0.00**

Table 17

Homogeneity of Variances - PPE Shortage

		Levene Statistic	df1	df2	Sig.
COVID-19 Cases	Based on Mean	0.44	1	13,071	0.50
	Based on Median	0.36	1	13,071	0.54
	Based on Median and with adjusted df	0.36	1	13,062.37	0.54
	Based on trimmed mean	0.39	1	13,071	0.53
COVID-19 Infection Rate	Based on Mean	0.62	1	13,192	0.43
	Based on Median	0.60	1	13,192	0.43
	Based on Median and with adjusted df	0.60	1	13,181.42	0.43
	Based on trimmed mean	0.57	1	13,192	0.44

Table 18

Homogeneity of Variances -Region

		Levene Statistic	df1	df2	Sig.
COVID-19 Cases	Based on Mean	159.12	3	13,172	<0.001**
	Based on Median	119.24	3	13,172	<0.001**
	Based on Median and with adjusted df	119.24	3	10,725.38	<0.001**
	Based on trimmed mean	137.51	3	13,172	<0.001**
COVID-19 Infection Rate	Based on Mean	5.21	3	13,244	0.00**
	Based on Median	4.83	3	13,244	0.00**
	Based on Median and with adjusted df	4.83	3	9,344.72	0.00**
	Based on trimmed mean	4.86	3	13,244	0.00**

Table 19

Homogeneity of Variances - Size

		Levene Statistic	df1	df2	Sig.
COVID-19 Cases	Based on Mean	484.89	2	13,212	<0.001**
	Based on Median	450.30	2	13,212	<0.001**
	Based on Median and with adjusted df	450.30	2	11,868.79	<0.001**
	Based on trimmed mean	463.86	2	13,212	<0.001**
COVID-19 Infection Rate	Based on Mean	10.83	2	13,283	<0.001**
	Based on Median	9.09	2	13,283	<0.001**
	Based on Median and with adjusted df	9.09	2	13,159.43	<0.001**
	Based on trimmed mean	9.71	2	13,283	<0.001**

Table 20

Normality Assumption for the *Dependent Variables*

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
COVID-19 Infection Rate	28.77	0.02	1841.93	0.04
COVID-19 Cases	1.73	0.02	6.51	0.04
Normalized COVID-19 Infection Rates	0.00	0.02	-1.20	0.04
Normalized COVID-19 Cases	0.00	0.02	-1.20	0.04

Table 21 shows the skewness and kurtosis for the COVID-19 infection rate variable, the COVID-19 cases variable, the normalized COVID-19 infection rates variable, and the normalized COVID-19 cases variable. COVID-19 infection rate and cases have a skewness value of 28.77 and 1.73 and kurtosis of 1841.93 and 6.51, respectively, indicating a significantly positive skewness and high kurtosis. The positive skewness and moderately high kurtosis of the COVID-19 infection rate and COVID-19 case variables indicate deviations from normality and possible outliers or extreme values. Normalized COVID-19 Infection Rates and Normalized COVID-19 Cases appear closer to a normal distribution, with skewness values relative to 0 and negative kurtosis values suggesting less extreme values.

Appendix B: 2020 NPALS Questionnaire

Form Approved
OMB No. 0920-0943
Exp. Date: 09/30/2023

National Post-Acute and Long-Term Care Study
2020 Residential Care Community Questionnaire

Dear Administrator or Executive Director,

The Centers for Disease Control and Prevention conducts the National Post-Acute and Long-Term Care Study (formerly known as the National Study of Long-Term Care Providers or NSLTCP). Please complete this questionnaire about the residential care community at the location listed below.

- **Due to the COVID-19 pandemic, we understand services at this residential care community may be temporarily suspended, reduced, or offered through alternative methods. Although some questions may be difficult to answer at this time, please complete the survey to the best of your ability.**
- If this residential care community is associated with another residential care community or is part of a facility or campus that offers multiple levels of care, please answer only for the residential care community portion operating at the location on the label below.
- Please consult records and other staff as needed to answer questions.
- If you need assistance or have questions, go to https://www.cdc.gov/nchs/npals/index.htm or call 1-877-256-8171.

Label here

☞ Residential care places are known by different names in different states. We refer to all of these places and others like them as residential care communities.

Just a few terms used to refer to these places are assisted living, personal care, and adult care homes, facilities, and communities; adult family and board and care homes; adult foster care; homes for the aged; and housing with services establishments.

Thank you for taking the time to complete this questionnaire.

Notice – CDC estimates the average public reporting burden for this collection of information as 30 minutes per response, including the time for reviewing instructions, searching existing data/information sources, gathering and maintaining the data/information needed, and completing and reviewing the collection of information. An agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to CDC/ATSDR Information Collection Review Office, 1600 Clifton Road, MS D-74, Atlanta, GA 30333; ATTN: PRA (0920-0943).

Assurance of Confidentiality – We take your privacy very seriously. All information that relates to or describes identifiable characteristics of individuals, a practice, or an establishment will be used only for statistical purposes. NCHS staff, contractors, and agents will not disclose or release responses in identifiable form without the consent of the individual or establishment in accordance with section 308(d) of the Public Health Service Act (42U.S.C. 242m) and the Confidential Information Protection and Statistical Efficiency Act (Title III of the Foundations for Evidence-Based Policymaking Act of 2018 (Pub. L. No. 115-435, 132 Stat. 5529 § 302)). In accordance with CIPSEA, every NCHS employee, contractor, and agent has taken an oath and is subject to a jail term of up to five years, a fine of up to $250,000, or both if he or she willfully discloses ANY identifiable information about you.

National Center for Health Statistics
Division of Health Care Statistics

Background Information

1. **Is this residential care community located in the same building as, on the grounds of, or immediately adjacent to each of the following settings?** MARK YES OR NO IN EACH ROW

	Yes	No
a. Independent living residences	☐	☐
b. Hospital	☐	☐
c. Nursing home or skilled nursing facility	☐	☐
d. Home health agency	☐	☐
e. Hospice agency	☐	☐
f. Adult day services center	☐	☐
g. A specific unit where subacute or rehabilitation care is provided	☐	☐

If you answered "Yes" to any item in question 1, please answer all questions only for the residential care community portion operating at the location on the cover page of this questionnaire.

2. **What is the type of ownership of this residential care community?** MARK ONLY ONE ANSWER
   - ☐ Private—nonprofit
   - ☐ Private—for profit
   - ☐ Publicly traded company or limited liability company (LLC)
   - ☐ Government—federal, state, county, or local

3. **Is this residential care community currently licensed, registered, certified, or otherwise regulated by the State?**
   - ☐ Yes
   - ☐ No → *Skip to **question 43***

4. **At this residential care community, what is the number of licensed, registered, or certified residential care <u>beds</u>?** *Include both occupied and unoccupied beds. If this residential care community is licensed, registered, or certified by **<u>apartment or unit</u>**, please count the number of single resident apartments or units as one bed each, two bedroom apartments or units as two beds each and so forth.*
   If none, enter "0."

   ☐ Number of beds

   → *If you answered fewer than 4 beds, skip to **question 43***

5. **Is this residential care community permitted, licensed or regulated to <u>only</u> serve adults with an intellectual or developmental disability, severe mental illness, or both?** *Do not include Alzheimer's disease or other dementias.* MARK ONLY ONE ANSWER
   - ☐ Yes, **both** intellectual or developmental disability and severe mental illness **only** → *Skip to **question 43***
   - ☐ Yes, **only** intellectual or developmental disability → *Skip to **question 43***
   - ☐ Yes, **only** severe mental illness → *Skip to **question 43***
   - ☐ No, none of the above

6. **Does this residential care community offer at least 2 meals a day to residents?**
   - ☐ Yes
   - ☐ No → *Skip to **question 43***

7. **What is the total number of residents currently living in this residential care community?** *Include residents for whom a bed is being held while in the hospital. If you have respite care residents, please include them.* **If none, enter "0."**

   ☐ Number of residents

   → *If you answered "0," skip to **question 43***

8. **Does this residential care community provide or arrange for <u>any</u> of the following types of staff to be on-site 24 hours a day, 7 days a week to meet any resident needs that may arise?** *On-site means the staff are located in the same building, in an attached building or next door, or on the same campus.* MARK A RESPONSE IN EACH ROW

	Yes	On an as needed basis or on call	No
a. Personal care aide or staff caregiver	☐	☐	☐
b. Registered Nurse (RN), Licensed Practical Nurse (LPN), or Licensed Vocational Nurse (LVN)	☐	☐	☐
c. Director, Assistant Director, Administrator or Operator (if they provide personal care or nursing services to residents)	☐	☐	☐

→ *If you answered "No" to 8a, 8b, <u>and</u> 8c, skip to **question 43***

9. Does this residential care community offer… MARK YES OR NO IN EACH ROW

	Yes	No
a. help with activities of daily living (ADLs), such as help with bathing, either directly or arranged through an outside vendor?	☐	☐
b. assistance with medications, such as the administration of medications, give reminders, or provide central storage of medications?	☐	☐

→ *If you answered "No" to both 9a and 9b, skip to **question 43***

10. Is this residential care community owned by a person, group, or organization that owns or manages two or more residential care communities? *This may include a corporate chain.*

☐ Yes
☐ No

11. Is this residential care community authorized or otherwise set up to participate in Medicaid?

☐ Yes
☐ No → *Skip to **question 13***

12. During the last 30 days, for how many of the residents currently living in this residential care community did Medicaid pay for some or all of their services received at this community? If none, enter "0."

☐ Number of residents

13. Does this residential care community only serve adults with dementia or Alzheimer's disease?

☐ Yes → *Skip to **question 17***
☐ No

14. Does this residential care community have a distinct unit, wing, or floor that is designated as a dementia, Alzheimer's, or memory care unit?

☐ Yes
☐ No → *skip to **question 17***

15. How many licensed beds are in the dementia, Alzheimer's, or memory care unit, wing, or floor? *If this residential care community is licensed, registered, or certified by apartments or units, please count the number of single resident apartments or units as one bed each, two bedroom apartments or units as two beds each and so forth.* If none, enter "0."

☐ Number of beds

16. Does this dementia or Alzheimer's Special Care Unit have… MARK YES OR NO IN EACH ROW

	Yes	No
a. higher staff-to-resident ratios compared to other units?	☐	☐
b. specially trained staff for residents with dementia or Alzheimer's disease?	☐	☐

17. An Electronic Health Record (EHR) is a computerized version of the resident's health and personal information used in the management of the resident's health care. Other than for accounting or billing purposes, does this residential care community use Electronic Health Records?

☐ Yes
☐ No

18. Does this residential care community's computerized system support electronic health information exchange with each of the following providers? *Do not include faxing.* MARK YES OR NO IN EACH ROW

	Yes	No
a. Physician	☐	☐
b. Pharmacy	☐	☐
c. Hospital	☐	☐
d. Skilled nursing facility, nursing home, or inpatient rehabilitation facility	☐	☐
e. Other long-term care provider	☐	☐

19. Does this residential care community typically maintain documentation of residents' advance directives or have documentation that an advance directive exists in resident files?

☐ Yes
☐ No → *skip to **question 21***

20. Of the current residents, how many have documentation of an advance directive in their file? If none, enter "0."

☐ Number of residents

21. Does this residential care community have the following infection control policies and practices? MARK YES OR NO IN EACH ROW

	Yes	No
a. Have a written Emergency Operations Plan that is specific to or includes pandemic response	☐	☐
b. Have a designated staff member or consultant responsible for coordinating the infection control program	☐	☐
c. Offer annual influenza vaccination to residents	☐	☐
d. Offer annual influenza vaccination to all employees or contract staff	☐	☐

Services Offered

22. Services currently offered by this residential care community can include services offered at this physical location or virtually (online or by telephone). For each service listed below… MARK ALL THAT APPLY IN EACH ROW

This residential care community…	Provides the service by paid residential care community employees	Arranges for the service to be provided by outside service providers	Refers residents or family to outside service providers	Temporarily does not provide, arrange, or refer for this service	Does not provide, arrange, or refer for this service
a. Hospice services	☐	☐	☐	☐	☐
b. Social work services—provided by licensed social workers or persons with a bachelor's or master's degree in social work, and may include an array of services such as psychosocial assessment, individual or group counseling, support groups, and referral services	☐	☐	☐	☐	☐
c. Mental or behavioral health services—target residents' mental, emotional, psychological, or psychiatric well-being and may include diagnosing, describing, evaluating, and treating mental conditions	☐	☐	☐	☐	☐
d. Therapy services—physical, occupational, or speech therapies	☐	☐	☐	☐	☐
e. Pharmacy services—including filling of or delivery of prescriptions	☐	☐	☐	☐	☐
f. Dietary and nutritional services	☐	☐	☐	☐	☐
g. Skilled nursing services—must be performed by an RN, LPN or LVN and are medical in nature	☐	☐	☐	☐	☐
h. Transportation services for medical or dental appointments	☐	☐	☐	☐	☐

23. *The Long-Term Care Ombudsman Program is an advocacy program that serves people living in long-term care facilities. The program works to resolve resident problems, and provides information to residents, their families and facility staff about resident rights, care and quality of life.* **During the last 12 months, how often did a Long-Term Care Ombudsman Program representative assist or visit this residential care community?** MARK ONLY ONE ANSWER

- ☐ At least once every three months
- ☐ Less than once every three months
- ☐ A representative assisted or visited, but unsure how often
- ☐ A representative did not assist or visit in the last 12 months → *Skip to* ***question 25***
- ☐ Don't know if a representative assisted or visited in the last 12 months → *Skip to* ***question 25***

24. During the last 12 months, what did the representative do for this residential care community? MARK YES OR NO IN EACH ROW

	Yes	No
a. Visited residents in-person	☐	☐
b. Contacted or interacted with residents remotely	☐	☐
c. Responded to resident complaints	☐	☐
d. Worked with resident or family councils—including attending meetings	☐	☐
e. Responded to staff requests for help with resident issues or resident advocacy	☐	☐
f. Provided information or education to staff on resident issues, such as resident rights, care or services	☐	☐
g. Recommended processes to improve resident rights, care or quality of life	☐	☐
h. Other	☐	☐

Resident Profile

25. Of the residents currently living in this residential care community, what is the sex breakdown? Enter "0" for any categories with no residents.

	Number of Residents
a. Male	
b. Female	
TOTAL	

NOTE: Total should be the same as the number of residents provided in question 7.

26. Of the residents currently living in this residential care community, what is the age breakdown? Enter "0" for any categories with no residents.

	Number of Residents
a. Under 65 years	
b. 65–74 years	
c. 75–84 years	
d. 85 years or older	
TOTAL	

NOTE: Total should be the same as the number of residents provided in question 7.

27. Of the residents currently living in this residential care community, what is the racial-ethnic breakdown? *Count each resident only once. If a non-Hispanic resident falls under more than one category, please include them in the "Two or more races" category.* Enter "0" for any categories with no residents.

	Number of Residents
a. Hispanic or Latino, of any race	
b. Two or more races, not Hispanic or Latino	
c. American Indian or Alaska Native, not Hispanic or Latino	
d. Asian, not Hispanic or Latino	
e. Black, not Hispanic or Latino	
f. Native Hawaiian or Other Pacific Islander, not Hispanic or Latino	
g. White, not Hispanic or Latino	
h. Some other category reported in this residential care community's system	
i. Not reported (race and ethnicity unknown)	
TOTAL	

NOTE: Total should be the same as the number of residents provided in question 7.

28. Of the residents currently living in this residential care community, about how many have been diagnosed with each of the following conditions? Enter "0" for any categories with no residents.

	Number of Residents
a. Alzheimer disease or other dementias	
b. Arthritis	
c. Asthma	
d. Chronic kidney disease	
e. COPD (chronic bronchitis or emphysema)	
f. Depression	
g. Diabetes	
h. Heart disease (for example, congestive heart failure, coronary or ischemic heart disease, heart attack, stroke)	
i. High blood pressure or hypertension	
j. Intellectual or developmental disability	
k. Osteoporosis	

29. For about how many of your current residents do you help store or manage their opioid pain medications? *Include reminders to take the opioid pain medication or handing the opioid pain medication to the residents to take. Examples include morphine, hydrocodone, oxycodone, codeine, fentanyl, and methadone, and combination opioid pain medications like hydrocodone, oxycodone, and codeine with acetaminophen. If none, enter "0."*

☐ Number of residents

30. Assistance refers to needing any help or supervision from another person, or use of assistive devices. Of the residents currently living in this residential care community, about how many now need any assistance in each of the following activities? Enter "0" for any categories with no residents.

	Number of Residents
a. With transferring in and out of a bed or chair	
b. With eating, like cutting up food	
c. With dressing	
d. With bathing or showering	
e. With using the bathroom (toileting)	
f. With locomotion or walking—this includes using a cane, walker, or wheelchair and/or help from another person	

31. As best you know, of the residents currently living in this residential care community, about how many were treated in a hospital emergency department in the last 90 days? If none, enter "0."

Number of residents

32. As best you know, of the residents currently living in this residential care community, about how many were discharged from an overnight hospital stay in the last 90 days? *Exclude trips to the hospital emergency department that did not result in an overnight hospital stay.* If none, enter "0."

Number of residents

33. As best you know, about how many of your current residents had a fall in the last 90 days? *Include falls that occurred in your residential care community or off-site, whether or not the resident was injured, and whether or not anyone saw the resident fall or caught them. Please just count one fall per resident who fell, even if the resident fell more than one time. If one of your residents fell during the last 90 days, but is currently in the hospital or rehabilitation facility, please include that person in your count.* If no residents had a fall, enter "0."

Number of residents

Staff Profile

34. An individual is considered an employee if the residential care community is required to issue a Form W-2 federal tax form on their behalf. For each staff type below, indicate how many full-time employees and part-time employees this community currently has. *Include employees who work at this physical location or virtually (on-line or by telephone).* Enter "0" for any categories with no employees.

	Number of Full-Time Employees	Number of Part-Time Employees
a. Registered nurses (RNs)		
b. Licensed practical nurses (LPNs) / licensed vocational nurses (LVNs)		
c. Certified nursing assistants, nursing assistants, home health aides, home care aides, personal care aides, personal care assistants, and medication technicians or medication aides		
d. Social workers—licensed social workers or persons with a bachelor's or master's degree in social work		
e. Activities directors or activities staff		

35. <u>Contract or agency staff</u> **refer to individuals or organization staff under contract with and working at this residential care community but are not directly employed by the community. Does this community have any nursing, aide, social work, or activities contract or agency staff?** *Include contract staff who work at this physical location or virtually (on-line or by telephone).*

- ☐ Yes
- ☐ No→ *Skip to* ***question 37***

36. **For** <u>**each**</u> **staff type below, indicate how many** <u>**full-time contract or agency staff and part-time contract or agency staff**</u> **this residential care community** <u>**currently**</u> **has.** *Do not include individuals directly employed by this residential care community.* Enter "0" for any categories with no contract or agency staff.

	Number of Full-Time Contract or Agency Staff	Number of Part-Time Contract or Agency Staff
a. Registered nurses (RNs)	☐	☐
b. Licensed practical nurses (LPNs) / licensed vocational nurses (LVNs)	☐	☐
c. Certified nursing assistants, nursing assistants, home health aides, home care aides, personal care aides, personal care assistants, and medication technicians or medication aides	☐	☐
d. Social workers—licensed social workers or persons with a bachelor's or master's degree in social work	☐	☐
e. Activities directors or activities staff	☐	☐

Information on COVID-19

37. **Since January 2020, how many coronavirus disease (COVID-19) cases did this residential care community have among residents and among employees or contract staff?** *Include only presumptive positive and confirmed cases.* Enter "0" if none or select don't know if you do not know the number.

	COVID-19 cases		COVID-19 cases that resulted in a hospitalization	Don't Know	COVID-19 cases that resulted in death	Don't Know
a. Residents	☐	If 1 or more →	☐	☐	☐	☐
b. Employees or contract staff	☐	If 1 or more →	☐	☐	☐	☐

38. **Since January 2020, how many residents with presumptive positive or confirmed COVID-19 infection did this residential care community need to transfer to another residential care community?** If none, enter "0".

☐ Number of residents

39. **Since January 2020, did this residential care community experience any of the following in your prevention, response, or management of COVID-19 infections?** MARK YES, NO, OR DON'T KNOW IN EACH ROW

	Yes	No	Don't Know
a. Screening of residents daily for fever or respiratory symptoms	☐	☐	☐
b. Notifying all residents or families of a case in the residential care community within 24 hours	☐	☐	☐
c. Use of telephonics or audio-only calls to assess, diagnose, monitor, or treat residents with presumptive positive or confirmed COVID-19 infection	☐	☐	☐
d. Use of telemedicine or telehealth (i.e., audio with video, web videoconference) to assess, diagnose, monitor, or treat residents with presumptive positive or confirmed COVID-19 infection	☐	☐	☐
e. Limiting of communal dining and recreational activities in common areas	☐	☐	☐

40. Since January 2020 to now, did this residential care community experience a shortage of the following personal protective equipment? MARK YES, NO, OR DON'T KNOW FOR EACH TIME PERIOD

	January 2020 to March 2020			April 2020 to June 2020			July 2020 to September 2020			October 2020 to now		
	Yes	No	Don't know	Yes	No	Don't know	Yes	No	Don't know	Yes	No	Don't know
a. Eye protection, gloves, face masks, or isolation gowns	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
b. N95 respirators	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

41. Since January 2020, how many residents with presumptive positive COVID-19 infection was this residential care community not able to test due to shortages of test kits? If none, enter "0".

☐ Number of residents

42. Since January 2020, did this residential care community impose restrictions on the following individuals from entering the building? MARK NEVER, SOMETIMES, OFTEN, ALWAYS, OR DON'T KNOW IN EACH ROW

	Never	Sometimes	Often	Always	Don't know
a. Family and relatives	☐	☐	☐	☐	☐
b. Visitors	☐	☐	☐	☐	☐
c. Volunteers	☐	☐	☐	☐	☐
d. Non-essential consultant personnel (e.g., barbers, delivery personnel)	☐	☐	☐	☐	☐

Contact Information

43. We would like to keep your name, telephone number, work e-mail address, and job title for possible future contact related to participation in current and future National Post-Acute and Long-Term Care Study (NPALS) waves. Your contact information will be kept confidential and will not be shared with anyone outside this project team. PLEASE PRINT

Your name	First Name		Last Name	
Your work telephone number, with extension	☐☐☐ — ☐☐☐ — ☐☐☐☐		Ext.	
Your work e-mail address				
Your job title				

Please return your questionnaire in the enclosed return envelope or mail it to:
NPALS
RTI International
ATTN: Data Capture
5265 Capital Boulevard
Raleigh, NC 27690

Thank you for participating in the 2020 National Post-Acute and Long-Term Care Study.