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Relationship Between Nursing Staffing Hours (RNs & LPNs) and COVID-19 Mortality in Indiana Nursing Homes

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This is to certify that the doctoral study by

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Doctoral Study Submitted in Partial Fulfillment

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Abstract

During the COVID-19 pandemic, many nursing homes struggled to meet the needed staffing levels, compromising service delivery in health institutions across the United States. The disproportionate effect of COVID-19 on various health care institutions and staff-patient ratios rejuvenated discussions on the longstanding workforce challenges on quality care and outcomes. The purpose of this quantitative study was to evaluate the relationship between registered nurse (RN) staffing hours and COVID-19 deaths in Indiana private and public nursing home residents based on the data obtained in the Care Compare database and Indiana Department of health COVID-19 portals. The independent study variables were RN and licensed practical nurse (LPN) staffing hours in the Indiana nursing home, and the dependent variable was COVID-19 deaths in Indiana nursing homes. Guided by the Donabedian theory, a descriptive and cross-tabulation analysis determined that RN staffing hours per patient per day significantly affected the COVID-19 mortality rate ($p = 0.0387$), implying that any change in RN staffing hours per patient per day resulted in a change in COVID-19 mortality. However, LPN staffing hours per patient per day had no statistically significant effect on COVID-19 mortality ($p = 0.0773$). Findings from this study contribute to positive social change by enabling health care administrators to make effective decision-making regarding human resources management, disaster management, and facility management disciplines to enact efficient and effective hiring practices during medical emergencies.

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Dedication

I give thousands of thanks to Allah (God) for his grace throughout this journey. As a health care administrator and nursing home administrator, this research has been essential because I witnessed many nursing staffing levels and COVID-19 mortalities in the nursing home. I want to dedicate this dissertation to all the health care heroes, including RNs, LPNs, CNAs, and other clinical and non-clinical healthcare workers who tirelessly work in nursing homes, hospitals, and any health care settings and take care of all the residents.

I want to dedicate this dissertation to my grandfather, Hirabhai Ravjibhai Patel, whom we lost in December 2021 during this journey. I also want to dedicate this dissertation to my grandmother SamjuBa; my father, Chandrakant Hirabhai Patel, who motivates me in every aspect of my life; my mother Aruna Chandrakant Patel; my little sister Naeema Chandrakant Patel; my lovely kids Rehaan, Muskaan, and Raiyaan; and finally, my beloved wife, Sujan Patel, who helped me thoroughly in this dissertation journey and continue helping me in the journey of my life. This journey could not be possible without her constant support and motivation to do the best for me, my family, and the community.

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Section 1: Foundation of the Study and Literature Review

Nurse understaffing compromises the quality of care because it undermines nurses' efficiency and productivity. Nursing homes have been struggling to meet the required staffing levels, leading to compromised quality delivery in nursing homes (Quinton, 2020). Frontline workers in the nursing homes in Indiana have often experienced high pressure because the facilities have one of the lowest staffing levels in the United States, making the staff's day-to-day work more expanded and tedious (Harrington, 2020). The understaffing in nursing homes has led to several medical quality issues (Quinton, 2020), such as increased medical errors (Indiana State Department of Health, 2019).

The COVID-19 outbreak worsened the situation in Indiana nursing homes. The pandemic forced the nurses in these institutions to work more hours to control infections and deaths (Quinton, 2020). However, at the inception of the COVID-19 management protocols, the facilities could not sustain infection rate control and death prevention because understaffing, alongside other challenges, compromised quality care provision.

This study was conducted to establish the relationship between nursing home staffing hours and the COVID-19 mortality rate in Indiana. The study examines two nurse categories: registered nurses (RNs) and licensed practice nurses (LPNs). RN and LPNs play an integral role in the recovery of any patient. Though LPN nurses provide primary nursing care and comfort to the patients, RN, on the other hand, assists a patient by administering medication, treatments, and other educational services (Gibbs, 2020). The study addressed the need to pay more attention to nurse staffing to offer quality care.

The results can help the state department of health review its policies on nurse staffing levels to develop a plan on appropriate minimum staffing levels and combat COVID-19 mortality. The study can also be used to encourage other health care providers to meet the required staffing hours to fight COVID-19 and other diseases. This will improve the level of health care treatment, support, education, and medication the public receives.

Background of the Study

COVID-19 Pandemic

The COVID-19 pandemic has significantly impacted the world since the first case was reported in December 2019 (World Health Organization, 2020). The first case of COVID-19 reported outside China was on January 13th, 2020, in Thailand (World Health Organization, 2020). The reported case marked the onset of COVID-19's spread to the rest of the world. By January 23rd, 2020, the United States, Nepal, France, Australia, Malaysia, Singapore, South Korea, Vietnam, and Taiwan had reported cases of COVID-19 (World Health Organization, 2020). The first death due to COVID outside China would on the same week be reported in the Philippines on February 2nd, 2020 (Cruz & Oliveira Dias, 2020).

COVID-19 has since been spreading worldwide, destabilizing the socioeconomic and political structures of the world. One of the sectors where the effects of COVID-19 have been witnessed is nursing homes. Nursing homes are high-risk locations for severe outcomes from outbreaks of COVID-19 due to the residents' old age, their recurrent chronic underlying health conditions, and the high rate of mobility health care personnel among facilities within a given region (McMichael et al., 2020). The effects of COVID-

19 on nursing homes were first acknowledged after an outbreak in Kirkland, Washington resulted in several deaths (McMichael, 2020). Since then, further outbreaks have emphasized the massive risk of COVID-19 in the older nursing home population regardless of the quality of the nursing homes (Farida, 2021). Even the best-prepared, highest-quality, and best-resourced nursing homes had terrible clusters of infections with high mortality rates (Farida, 2021).

Much has been done to curb the significant COVID-19 deaths in nursing homes. Most nursing homes enrolled the residents for mass vaccination. The efforts by the U.S. government to distribute vaccines aided the reduction of COVID-19 deaths in nursing homes. By July 25th, 2021, about 88% of persons above 65 years, including nursing home residents, had been vaccinated (Centers for Medicare and Medicaid Services, n.d.-a). The high vaccination rate dropped the COVID-19 mortality rate in nursing homes from 6,000 deaths per week in December 2020 to about 200 deaths per week in August 2020.

In Indiana, COVID-19 has continued to be a big challenge in the health sector, especially in nursing homes. Since the first case was reported in the United States, Indiana has experienced 740,613 cases, while the total mortalities are 13,518 deaths (In.gov, 2021-a). With an already struggling health sector, Indiana was one of the most hit states in the United States (Kosar & Reber, 2021). At least 47% of the population in Indiana received a full vaccine dose, and 51% received at least one dose. Those 65 years and above and nursing home residents cumulatively have at least 81% fully vaccinated and 83% receiving at least one dose of the vaccine (In.gov, 2021-b).

Despite the current vaccination statistics depicting improved efforts towards combating the spread and deaths because of COVID-19, more still needs to be done to supplement actions already in place. For instance, nursing homes with nurse staffing shortages and those with overcrowding are more vulnerable to COVID-19's spread. Nursing homes that cared for more residents reported more weekly new COVID-19 cases than those that cared for fewer patients (Figueroa et al., 2020). As nurse staffing demands continually increased to deal with the ever-rising COVID-19 infections and deaths, privately-owned nursing homes increased nurse staffing to remedy the pandemic's debilitating effects (Li et al., 2020). Though it has been noted that nursing homes with nurse staffing shortages are recording relatively higher COVID-19 infection and mortality rates, minimal studies have been conducted to investigate if there is a significant association between the two variables. Therefore, it is essential to know the significance of nurse staffing in combating the high rate of infections and deaths in nursing homes. The findings will help guide an approach to nursing homes' nurse staffing and COVID-19 situations (see Hu et al., 2021).

Registered Nurses

In the United States, RN nurses deliver vital health care services to the public in all need hours. RNs are caregivers with several duties to ensure that their patients receive proper care and support from other providers (Malvik, 2020). With the defined responsibilities, it is evident that the number of RN nurses in any health facility may be significant in determining the quality of health care services a patient will receive from such a facility. With the outbreak of the COVID-19 pandemic, RN jobs, responsibilities,

and descriptions were overstretched (Bullington, 2021). These nurses were on the frontline in the fight against the pandemic. The nurses also doubled up as the caregivers for non-COVID-19 patients that needed care during the pandemic. They also evaluated and monitored the community to assess the pandemic trends to ensure the community was safe from the pandemic (Bullington, 2021). They were also expected to plan for anticipated COVID-19 waves and outbreaks of COVID-19-related conditions. The duties and expectations increased the demand for nurses, resulting in health care situations that overloaded the medical system. RNs also led the sensitization, supply, and overseeing of effective usage of sanitation materials and personal protective equipment. They also offer screening information, confinement guidelines, and triage procedures built on the up-to-date guidelines. Therefore, to ensure effective management of this pandemic, there should be robust nursing staff engagement during awareness creation, knowledge exchange, clinical processes, and public safety.

Licensed Practical Nurses

LPNs' role is to support the primary health care team and operate under RNs, advanced practice registered nurses, or main doctors (Unruh, 2019). They are essential in ensuring that the patient's well-being is taken care of throughout the health care journey. They do this by offering routine and primary care. Since they provide critical assistance to the core health care practitioners, they are also found in many working environments such as clinics, schools, assisted living facilities, nursing homes, and many other health care facilities. LPNs were also on the frontline in the war against the pandemic. Though there is no clear evidence that increasing the nurse staffing hours may reduce mortality

due to COVID-19, going by the role these noble staff play, there is likely to be a connection between the number of nurses in a facility and the mortality recorded.

Knowledge Gap

RN and LPN nurses are essential in ensuring patients receive quality health care in nursing homes. Despite their importance, many researchers have not established if these nurses' staffing hours can help reduce COVID-19 mortality (Bullington, 2021). Since these nurses play an essential role in caring for COVID-19 residents in nursing homes, their staffing level, which is directly associated with staffing hours, may significantly affect COVID-19 mortality (Bullington, 2021). Therefore, this study was conducted to fill this knowledge gap and present knowledge of any existing association between RN and LPN staffing hours and COVID-19 mortality.

Problem Statement

The COVID-19 pandemic has affected institutions such as nursing homes. For instance, Indiana is one of the states in the United States where nursing homes are experiencing several low RN and LPN nurse staffing hours per patient, which compromises the quality of care received by nursing home residents (John, 2021). With the COVID-19 pandemic, the nursing homes are experiencing a shortage in both RN and LPN nurses due to increased demand for care versus the low number of nurses, increasing the chances of further exposing the residents to the hazards of the virus (Xu et al., 2020). Even though nursing homes had been experiencing many deaths before COVID-19, COVID-19 caused a massive spike in these numbers (Loubert, 2021). Nursing home mortalities due to COVID-19 accounted for 35% of the total mortalities

(John, 2021); despite long-term facilities representing just 0.4% of the total population, this population accounted for approximately half of the deaths from COVID-19. Between March 1st, 2020, and June 1st, 2020, a total of 1,629 deaths were reported among people institutionalized in analyzed nursing homes, of which COVID-19-related deaths were 1,089 (66.9%), and the remaining 540 deaths were due to other different causes (Loubert, 2021; Suñer et al., 2021).

The high number of deaths in nursing homes is associated with multiple factors, among them, understaffing (Bagchi et al., 2020). There has also been public scrutiny of the impact of COVID-19 and trying to understand the significant influences on COVID-19 mortality (Xiang, 2021). However, no studies exist in the literature that gives a specific breakdown of the relationship between nurse staffing per patient per day and COVID-19 mortalities in nursing homes, even though there is the existence of operational problem where there are nursing homes that are unable to care for patients due to lack of sufficient staffing (Shalom, 2021). The only existing systematic data collection on the deaths occurring in nursing homes is from the Centers for Disease Control and Prevention, which does not include nurse staffing hours (Centers for Medicare and Medicaid Services, n.d.-a).

To fill this gap, I developed this study to establish any relationship between RN staffing hours per patient per day and LPN staffing hours per patient per day and COVID-19 mortality. I applied secondary data collected across several nursing homes in Indiana. The COVID-19 mortality dataset was obtained from the National Library of Medicine, and the staffing hours per patient per day dataset was obtained from JAMA

international medicine (Xiang, 2021). This study presents the statistical findings of the data analysis to obtain how RN and LPN staffing hours are associated with the COVID-19 pandemic.

Purpose of the Study

This quantitative study aimed to evaluate the relationship between RN and LPN staffing hours and COVID-19 deaths in Indiana State private and public nursing home residents based on the data obtained in the Care Compare database and Indiana Department of health COVID-19 portals. The independent study variables are RN and LPN staffing hours in the Indiana nursing home, and the dependent variable is COVID-19 deaths in Indiana nursing homes. The results can be used to determine whether staffing levels can be addressed to affect COVID-19 mortality rates.

Research Questions and Hypotheses

Research Question 1: Is there an association between RN staffing hours and COVID-19 deaths in Indiana State private and public nursing home residents based on the data obtained in the Care Compare database and Indiana Department of Health COVID-19 portals adjusting for nursing home size, ownership type, and rural location?

$H_0$1: RN staffing hours have no statistically significant relationship with COVID-19 deaths in Indiana state nursing homes.

$H_1$1: RN staffing hours have a statistically significant relationship with COVID-19 deaths in Indiana state nursing homes.

Research Question 2: Is there an association between LPN staffing hours and COVID-19 deaths in Indiana state private and public nursing home residents based on the

data obtained in the Care Compare database and Indiana Department of Health COVID-19 portals adjusting for nursing home size, ownership type, and rural location?

$H_0$2: LPN staffing hours have no statistically significant relationship with COVID-19 deaths in Indiana state nursing homes.

$H_1$2: LPN staffing hours have a statistically significant relationship with COVID-19 deaths in Indiana state nursing homes.

Theoretical Foundation

The theoretical foundation for this study is built on Donabedian's structure-process-outcome tailored to health care quality (Berwick & Fox, 2016). Donabedian introduced a methodology for measuring structure, process, and outcome and equally contributing to prioritizing governance and management, supported by measurement as measurements of the effectiveness and efficiency of health services. The study variables, RN and LPN staffing, are critical factors related to health care structure. Staffing is an essential factor influencing the quality of care (Anders et al., 2011), and mortality is a quality care measure. Inadequate quality care means high mortality. Based on this model, I considered staffing levels in nursing homes as one of the factors affecting care quality, and COVID-19 is one of the problems that need to be solved to improve health care quality.

Donabedian's Structure-Process-Outcome

The selected model is the Donabedian framework that entails structure, process, and outcome. The Donabedian framework has been used to evaluate and compare the quality of medical care in the United States. The framework was used to evaluate health

care services' quality, and information regarding medical care quality is drawn from the three tenets (Berwick & Fox, 2016). Structure denotes the health care delivery context (setting) and instruments used in delivering care-organizational characteristics, material resources, and human resources (staffing). Process denotes the activities and interactions between health care providers and patients. These activities encompass health care activities such as treatment, diagnosis, prevention, and rehabilitation services. Interpersonal aspects such as counseling, decision making, patient education, and communication fall under these processes. Outcome denotes the health consequences and welfare, indicating the patient's state of health and future health attributable to health care delivery alterations. Outcomes can be categorized under system, organization, or population level. They include physical, clinical, psychological, physiological-biochemical, social-psychological, evaluating, and integrative outcomes. These outcomes are applicable in various community settings. Thus, the framework remains dominant in assessing health care quality.

Patient characteristics and clinical interventions are essential in Donabedian's model. The model relates several factors that affect quality, including the dynamic relationships that affect various components (Mitchell et al., 1998). It also articulates client and contextual factors' impact on health care practice (Gilmartin & Sousa, 2016). The model recognizes the influence of these factors in a bidirectional nature in which client characteristics and context impact interventions to produce outcomes. The model emphasizes that no single intervention directly acts through the client only or the context only. An intervention's effects are mediated by context and client factors but do not

affect outcomes directly. The model proposes appealing relationships tested extensively in research and found to have significant meaning.

Despite its worldwide application in several settings, this study will present the first exploration of Donabedian's model in COVID-19 infection control and prevention through nurse staffing hours and how nurse staffing potentially impacts patient safety and approaches to improve patient outcomes in the context of nursing homes. The Donabedian theory provides a model that relates multiple factors that influences the quality of care to desired outcomes (Mitchell et al., 1998). The model provides a process in which health care can continuously measure and monitor critical care indicators and identify risk factors that might lower quality. For example, the model builds a predictive model for nursing home residents' continuous quality improvement (Thoof, 2021). The Donabedian model allows researchers and policymakers to conceptualize the underlying mechanisms and identify risk factors likely to compromise the quality of care in nursing homes.

Based on the theoretical foundation, I related nurse staffing hours per patient per day to human resource factors that the model gives as factors that can be classified as structure factors. The total number of hours a patient receives care from an RN or an LPN relates to the process indicator since it reflects how care is offered to the residents. Finally, mortality can be an outcome indicator. Quality care reduces mortality; where quality care is compromised, the mortality is likely to be higher. The next step is to find the association between the structure, process, and outcome. Because the process indicator (hours of care) is a function of the structure indicators (nurse staffing hours per

patient per day), I did not need to look for the association between structure and process in this case. Thus, I investigated the association between nurse staffing hours per patient per day and COVID-19 mortality.

Nature of the Study

To address the research questions in this quantitative study, I used a cross-sectional design with the data being analyzed using a multivariate regression analysis design. The research design is cross-sectional because I used the data collected across the nursing home at one specific time (i.e., the data are not recorded over a period). I intended to use data showing the situation when obtaining the data instead of how the situation has been. To settle on the analysis design, the key factors considered included the aim of the project and the nature of the data collected for the dependent variable. My objective aims to establish the relationship between nurse staffing hours and COVID-19 mortality.

Regression is a critical analysis method used to investigate the association because it measures how change influences dependent variables affect independent variables (Leavy, 2017). Regression can also help test whether this association is statistically significant or if the changes are just due to chance. Before proceeding with the analysis, multicollinearity and heterogeneity of the variables were tested. After that, another inferential analysis was conducted to establish the relationship between the variables. Correlation analysis also helped understand how staffing levels influence the COVID-19 spread and deaths. Regression analysis depicts the relation and the extent to which independent variables affect the dependent variable.

Literature Search Strategies

To develop the literature review, I used scholarly journals, past study reports, health professions journals, and books from the Walden University e-library. The search engines employed were Google Scholar, Microsoft academics, Worldwide Science, and ResearchGate. In mounting a literature search, the keywords and databases searched included *staffing hours*, *staffing levels*, *nursing home staffing*, *COVID-19 in nursing homes*, and *staffing hours and COVID*-19. In the following sections, I discuss empirical literature that justifies the study and supports the theoretical framework.

Literature Review

Nursing homes have been experiencing challenges in staffing (Office of the Assistant Secretary for Planning and Evaluation, 2020). With these low staffing levels threatening the delivery of health care services, nursing homes have struggled to address the increase of deaths due to COVID-19 (Office of the Assistant Secretary for Planning and Evaluation, 2020). Several states in the United States, including Indiana, are among the most hit places by the pandemic. Many residents have reported COVID-19 cases and deaths across the state and in nursing homes. Although researchers have investigated this issue, there is little or no literature on how nursing staffing levels play a role in managing COVID-19 infections and deaths. Almost all the research was conducted within the first nine months of the pandemic and does not give a broad relationship between staffing levels and COVID-19 cases and deaths in nursing homes. In this quantitative study, I examined the relationship between COVID-19 deaths as the dependent variable and nursing homes' RN nursing staffing hours and LPN nursing staffing hours being the

independent variables. Correlation analysis helped understand how staffing levels influence the COVID-19 spread and deaths, and regression analysis depicted the relationship and the extent to which independent variables affect the dependent variables (see Leavy, 2017).

Literature Review Related to Study Variables

Previous research has established that nurse staffing hours for licensed nurses (RN and LPN) had a statistically significant association with the probability of discharge home and significantly reduced death in nursing homes (Bliesmer, 1998). Thus, there is a need to increase nurse staffing to set appropriate levels to improve quality. As a result of the COVID-19 pandemic globally, deaths have significantly increased in nursing homes (Su-Hong, 2021). It is therefore essential to examine if these nurse staffing hours (LPN and RN) have any effect in reducing COVID-19 deaths in nursing homes in Indiana.

Nurse Staffing in Nursing Homes

The primary goals of U.S. health care reformation have been improving care quality, expanding access, and reducing associated health care costs (Chee et al., 2016). The 2010 Affordable Care Act was passed to implement new health care delivery models to reduce costs and improve care quality. As a result, the emphasis shifted to value-based health care, which penalizes or rewards hospitals for attaining a benchmark on cost, patient outcomes, and quality metrics. Nurses comprise the largest clinical subgroup, and organizations bid to optimize quality resorted to reducing professional nurse staffing hours and associated costs. However, the strategy does not yield results, as optimizing

staffing levels is crucial for care and optimal patient outcomes (Abuown et al., 2020; Bagchi et al., 2021; Harrington et al., 2020; Werner & Coe, 2021; White et al., 2020).

Nurse staff can provide effective and safe care in the appropriate organizational environment (Ghavidel et al., 2019). RNs provide surveillance, leadership, and care coordination. Certified nurse assistants (CNAs) and LPNs deliver a significant majority of nursing homes' direct patient care across the states (White et al., 2020). However, nursing homes face several challenges in their ability to attract and retain a sufficient number of qualified nurses, CNAs, and LPNs with adequate skills, knowledge, and attitudes to care for acute health care needs, chronic disease burden, and the emergence of new pandemics (White et al., 2020). Many nursing homes fail to reach the CMS staffing levels, and high turnover and attrition rates worsen the problem (Figueroa et al., 2020; Werner & Coe, 2021). High nursing staff turnover rates are linked with poor care quality and higher costs incurred in recruitment, training, and loss of productivity (White et al., 2020). The costs are problematic for nursing homes that hugely rely on Medicaid reimbursement and operate within tight budgets. Job dissatisfaction and high turnover rates are drivers of high turnover rates among nursing staff (Oppel & Young, 2018; White et al., 2020).

Extensive sources support the link between better quality in NHS due to higher nurse staffing, where RNs staffing has a higher association with better clinical outcomes, including increased patient safety (Bagchi et al., 2021; Fawaz et al., 2020; Harrington et al., 2020; Li et al., 2020; Oppel & Young, 2018; White et al., 2020). Merits of higher staffing levels include economic and clinical improvements (higher rates of patient

satisfaction, patients' improved quality of life, decreased medical/medication errors, reduced length of hospital stays, and decreased medical costs due to readmissions), decreased re-hospitalization rates, decreased patient mortality cases, and deceased preventable events-healthcare-associated infections (HAIs), patient falls, central line infections, hospital-acquired pneumonia, pressure ulcers, and other complications that occur due to hospitalization (Gorges & Konetzka, 2021; Oppel & Young, 2018; White et al., 2020). Higher nurse staffing is also associated with higher rates of job satisfaction (White et al., 2020), nurse retention, and lower rates of burnout which contribute to safe patient care (Haegdorens et al., 2019). Appropriate nurse staffing is associated with improved outcomes fulfilling the objective of value-based care. Therefore, higher staffing is essential for cost-effective, high-quality care (Chee et al., 2016).

Adequate nurse staffing is also essential in nursing homes during the COVID-19 crisis (Ouslander & Grabowski, 2020). Following the COVID-19 pandemic, care complexity and patient acuity in nursing homes have increased, increasing the demand for high-quality skilled nursing care (Belmin et al., 2020). According to Harrington et al. (2020), the COVID-19 pandemic has led to ≥ 25,923 mortalities and ≥ 449 staff mortalities in nursing homes. By June 1st, 2020, over 80% of the nursing homes had been affected. A vulnerable population of ≥1.4 million nursing home residents in ≥15,600 nursing homes are predisposed to the disease (pp, 7). The majority are older than 65 years, ≥ 60% have chronic illnesses, and over two-thirds of the population requires assistance with assisted living activities due to cognitive impairments. Residents who share rooms are also predisposed to contracting coronavirus infection.

Nurses' Roles and Responsibilities in COVID-19 Pandemic

As frontline health care workers, nurses played a crucial role during the COVID-19 pandemic because they offered direct patient care and monitored and evaluated communities (Fawaz et al., 2020). Nurses ensured COVID-19 patients acquired high-quality skilled, and personalized patient care (Al Thobaity & Alshammari, 2020). They also planned for outbreak cases that fueled the demand for health care and nursing services—the COVID-19 pandemic overloaded health care systems (Ouslander & Grabowski, 2020). Using personal protective materials, sanitation resources, triage protocols, confinement guidelines, and screening information, nursing staff fulfilled their roles toward COVID-19 patients and the public (Bagchi et al., 2021; Harrington et al., 2020; Li et al., 2020).

Managing global pandemics like the COVID-19 pandemic requires practical, strong, and engaged nursing staff to meet the community's needs. However, care triage results in a clash between the nurse and health care providers' responsibility to patients during pandemics such as COVID-19, as caring for COVID-19 patients in clinical environments strain scarce resources. According to Fawaz et al. (2020), nurses are exposed to hazards at the frontline of the pandemic response. They must protect themselves using infection prevention procedures and protective gear, including masks, ventilators, face shields, eye covers, and gloves (Fawaz et al., 2020). Nurses must be supported in the pandemic. Nurses have roles in public awareness in disease prevention, vaccination, and addressing myths and misconceptions circulating fast in public through

various outlets, including social media (Al Thobaity & Alshammari, 2020). Nurses' roles include countering myths with evidence-based information.

In the middle of the pandemic, nurses actively intervened to stop the spread and adequately manage COVID-19 patients (Bagchi et al., 2021). However, they could not effectively contain the outbreak without additional support. Health institutions and nursing homes were not well equipped to handle the pandemic. Belmin et al. reiterated the\the need to investigate whether sufficient staffing plays a significant role in managing a pandemic (2020). Evidence-based modifications in the COVID pandemic included support to nurses with resources, nurse engagement, and changes in organizational cultures to support the delivery of care at a time when the pandemic calls for increased care. Moreover, staffing issues needed the attention of nurse leadership opportunities for staff development and engagement, interdisciplinary work, shared clinical decision-making, and evidence-based standards of care to address the dissatisfaction and provide interventions for burnout reduction (White et al., 2020).

COVID-19 affected health care providers globally as the stresses overwhelmed healthcare systems and frontline health care providers such as nurses (Belmin et al., 2020). Al Thobaity & Alshammari (2020) explored the issues affecting nurses' preparedness to battle the pandemic through an integrative review of 8 articles published between 2019 December and April 2020. The study incorporated papers published in English and highlighted nurses' challenges in response to the crisis. Selected studies highlighted staffing shortages, lack of appropriate communication with patients, mental health concerns (depression, anxiety, fear), and burnout from long working hours without

appropriate self-care. A second theme emerging from the review was the lack of resources, including personal protective equipment and medical supplies. The review indicated nurse staffing shortages with the severity of trained personnel. The problem was exacerbated by staff shortages of nurses in intensive care units or COVID-19 isolation units. The COVID-19 problem exposed the shortage of critical care and emergency care nurses and other specialties.

Belmin et al. examined potential solutions to the shortage problem, such as training new nurses and staff on patients on mechanical ventilators and recalling retired staff who have the skills, attitudes, and knowledge to provide care to patients in the pandemic (2020). This can increase the capacity of hospitals to receive and care for more patients. Other potential solutions involve incorporating interns and students into the clinical environment to assist with the burden as volunteers (pp, 5). Nursing experts on disaster preparedness and emergencies are essential in the fight against the pandemic. They offer helpful insight by highlighting the possible pandemic risks and short-term and long-term adjustments to counter the presented risks (pp, 6). Training is also vital for self-care and using personal protective equipment (PPE) for isolated cases. Following the pandemic, the CDC identified nursing homes as high-risk areas for transmissions due to congregate settings. Residents are also at high risk for mortality and morbidity than the average population depending on underlying medical conditions and older age. The nationwide surveillance of nursing homes by the CDC's National Health Safety Network requires NHs to begin routine reporting and enrollment of COVID-19 cases (pp,7).

Harrington et al. (2020) outlined that nursing staff had a fundamental responsibility for infection control in nursing homes. Nursing homes rely on adequate nurse staffing with relevant educational qualifications, experience, and skills to comply with federal regulations. These homes must ascertain residents' safety (mental, physical, and psychosocial) and wellbeing. Nursing staffing must be based on the care needs of residents and tailored to each facility. Even though minimum staffing levels are specified, nursing homes should always have adequate RNs, LPNs/LVNs, and CNAs to meet all residents' health needs. Nurse staffing improves outcome and process measures of quality, and the total effect of minimum staffing with the three cadres is an overall improvement in care quality.

According to Harrington et al. (2020), a higher number of RNs is also associated with improved quality indicated by decreased infections, improved activity of daily living independence among residents, decreased pressure ulcers, fewer weight loss cases, fewer pressure ulcers, lower rates of mortality, lower use of restraints, fewer dehydration cases, reduced improper antipsychotic overuse. Besides, it also leads to better morning care. Higher nurse staffing levels are associated with reduced readmissions and decreased use of the emergency rooms in nursing homes. Adequate staffing is associated with lesser violations of federal regulations for quality. Inadequate staffing leads to missed care associated with adverse events such as medication errors, pressure ulcers, new infections, poor patient safety culture, IV fluids leaking or running dry, and increased patient falls. Missed care is also highly related to RN burnout and job dissatisfaction. Adequate nurse

staffing can prevent harm to residents. Higher staffing is essential for increasing resident acuity (Harrington et al., 2020).

Justification Literature

An estimated 27% of mortality cases due to COVID-19 have occurred in nursing homes (NHs). However, some facilities have had better success limiting the spread of the disease than others. Figueroa et al. (2020) examined the rate of COVID-19 cases between low and high-performing nursing homes from the CMS benchmark. The study evaluated data from eight states, including New Jersey, Connecticut, California, Florida, Maryland, Pennsylvania, and Massachusetts. The study highlights a high association between COVID-19 deaths and nursing home residents, accounting for 27% of cases. In addition, the study evaluated whether nursing homes rated highly by the CMS based on quality measures such as nurse staffing and health inspections had lower disease rates than facilities that ranked lower. The study evaluated 4254 nursing homes in the United States with classic nurse staffing, quality measures, and health inspection ratings. About 34.1% had higher ratings for health inspection, 35.9% for nurse staffing, and 70.1% for excellent quality measures.

Findings of this study indicate that high-performing nursing homes had more than 30 cases compared to lower-rated facilities across the three domains. After adjustments, nursing home ratings in quality measures and inspections did not significantly affect COVID-19 cases. However, after adjustments nursing homes that ranked better in nurse staffing were less likely to be associated with <30 cases than lower-rated nursing homes. NH with better nurse staffing in the eight states had fewer cases than those with lower-

rated facilities. The burden of COVID-19 disease was similar between high and low-performing NHs for quality measures and health inspections, suggesting that nurse staffing shortages in facilities predispose them to the spread of the disease and more cases. Authors call for policies that support appropriate nurse staffing to manage the spread of COVID-19 disease effectively. Limitations of the study include data inclusion from 8 states only, ranking among the hardest hit with COVID-19. State data is more reliable than national data. High-performing NHs have higher and better diagnosis capacity leading to better detection of the cases. This may underestimate the association between low performance on staffing and the diagnosis of a higher number of cases.

Belmin et al. (2020) implied that research on staffing levels in nursing homes has been inadequate in the middle of the COVID-19 crisis. Research captures the importance of adequate staffing in ensuring high-quality care in nursing homes. This ensures an effective response to a pandemic. The study evaluated the data using payroll-based staffing data from the CMS. Findings indicated a decline in nursing homes' total number of hours and the average census during the pandemic. Following adjustments to the number of staff hours in direct care following a decline in the census, the nurse staff hours slightly increased or remained steady during the pandemic. Observed increases in staff hours per resident are minimal but were concentrated in counties with a higher prevalence of COVID-19 cases, nursing homes with not-for-profit homes, and homes with a low census of Medicaid. The latter typically have more financial resources, while not-for-profit nursing homes allocate more resources to nurse staffing. The findings of the two studies raise essential concerns that despite the regular nurse staffing hours based

on decreased census, shortages may have been driven by increased demands and stresses on nursing staff following the COVID-19 pandemic.

On the other hand, Li et al. (2020) investigated the associations between RN staffing in nursing homes with the overall care quality and the concentration of racial/ethnic residents and Medicaid residents with confirmed COVID-19 cases and deaths by April 16th, 2020, among residents of nursing homes in Connecticut. The study employed a cross-sectional analysis of 215 Connecticut NHs with COVID-19 reports linked to other facilities with counts of confirmed mortality and morbidity cases. Associations of home characteristics with the likelihood of at least one confirmed case and at least one confirmed death count were analyzed through multivariable two-part models. The study's findings indicated an average of 8 confirmed cases in the nursing homes. However, 107 facilities had no confirmed cases. The average number of deaths was 1.7 per NHs, whereas 131 facilities did not record patient mortalities from COVID-19. In facilities with ≥1 confirmed COVID-19 case, a twenty-minute increase per resident day in RN staffing was associated with fewer cases (22%) than 1-3-star facilities, 4-star or 5-star facilities, with 13% fewer cases. Facilities with a higher concentration of ethnic/racial minorities and Medicaid residents recorded 16% and 15% more cases, respectively, compared to other facilities. In facilities with ≥1 confirmed COVID-19 death, a twenty-minute increase per resident day in RN staffing was associated with fewer COVID-19 deaths by 26%. There were few associations between mortalities and other variables being examined. The study indicated more cases confirmed in nursing homes with ethnic/racial minorities and predominant Medicaid residents. The study

denotes that higher RN staffing can control coronavirus spread and reduce mortality cases in nursing homes.

Harrington et al. (2020) studied the relationship between nurse staffing in California homes, comparing homes without and residents with confirmed COVID-19 cases. The study incorporated the LA Public Health Department data and reported COVID-19 infection between March and May 2020. Data were retrieved from California's Medicare and Medicaid nursing homes with an exemption of residential care facilities and assisted living facilities. Nursing homes in the study recorded infections between May 15th and March 4th. The study relied on Public Health Department reports and outbreaks recorded in California NHs. The authors included 272 NHs that reported cases in both residents and staff. Over 102 homes that had reported staff cases without residents were excluded. The study thus included 819 NHs without cases and 272 that had reported ≥1 case.

Harrington et al. (2020) used data analysis methods that included logistic regression analyses, bivariate analyses, and correlation analyses using IBM SPSS ver. 26. Bivariate analyses compared nursing homes to those without cases of COVID-19. The Pearson Chi-square test was used for dichotomous measures, while ANOVA was used to analyze continuous measures. Pearson correlational analyses were done to explore multicollinearity for predictor variables. Correlation and bivariate analysis results further guided the logistic regression models. The study's findings indicated that nursing homes with total RN staffing levels below the recommended minimum standards had double the probability of having residents with infections. Nursing homes with lower Medicare

ratings on RN and total nurse staffing, higher deficiencies in the total health, and more beds had a relatively higher probability of having residents with COVID-19 infections. Nursing homes with low total nurse staffing and RN staffing appeared to leave COVID-19 patients vulnerable.

Limitations of the study include the inclusion of NHs from one state. Generalizability to other states is limited. Staffing levels in California NHs are similar to the national statistics, where over 70% fall below federal staffing levels. Secondly, facilities identified as not having and having COVID-19 infections were primarily based on self-reported data from the facility. Inadequate testing could have contributed to undercounting COVID-19 cases. Whereas higher staffing levels, use of PPEs, infection control measures, and widespread testing may contain spread or delay it, the infection may not be entirely preventable. Other factors that affected the study results include the availability of PPEs, the number of COVID-19 tests performed, staff preparedness in pandemics, and better data on infections and mortalities. Lastly, quality ratings of hospitals and staffing levels may have fluctuated during the study period. At the pandemic's beginning, the staffing levels may have been reduced due to staffing shortages (infections, reluctance to work, decreased state oversight).

The study's implications for policy reiterate the need for minimum staffing levels in nursing homes. Adopting higher regulations from CMS for higher standards of minimum staffing levels. Inadequate staffing was a challenge before the pandemic and may have resulted in negative consequences. The study revealed that low RN staffing and a low total nurse staffing leave residents more vulnerable to coronavirus infections. For-

profit nursing homes were associated with lower RN staffing and sub-par Medicare quality ratings after adjustments for acuity. For-profit nursing homes had more health deficiencies than government facilities and nonprofit homes. The findings with the highest margins have the most inferior quality. Substitution of RNs for LPNs and LVNs for cost reductions does not appear to improve care quality, underpinning the importance of RNs' inadequate infection control and nursing care in the COVID-19 pandemic (Harrington et al., 2020). The study demonstrated the need for higher RN staffing to improve care quality during the COVID-19 pandemic.

Bagchi et al. (2021) utilized CDC's NHSN reporting data between May 25th and November 22nd, 2020. The data was used to describe COVID-19 infection rates among residents in NHs and staff members and compare them to the surrounding regions. The study indicates that residents' infection cases increased in NHs during June and July (11.5 cases/1,000 resident weeks). The rates declined in September to 6.3cases/1,000 resident weeks). In late November, the rates increased to 23.2 cases/1,000 resident weeks. Among nursing staff, the infection rates increased during June and July, declined between August and September, and increased again in November, similar to infection rates among NHs residents. Surrounding communities' COVID-19 infection rates increased with similar trends. The authors hypothesized the increased association with increased cases in nursing homes. The authors call for strategic mitigation efforts with a comprehensive plan to monitor coronavirus infections in nursing homes and ways to mitigate transmission in high-risk facilities.

CMS-certified NHs reported NSHN data, including the number of beds occupied, the number of COVID-19 cases confirmed by laboratory viral nucleic acid tests, or results from antigen tests. The nursing home staff included personnel working/volunteering at the facility, including resident caregivers, temporary staff, contractors, and other members who work at other facilities. COVID-19 information reflecting confirmed data on staff members was collected in all US states, Puerto Rico, Guam, and the District of Columbia. Facilities that did not report specific data weekly were excluded from the study. The study analyses were conducted using SAS software ver. 9.4 and CDC reviewed the activity applying CDC policies and applicable federal rules. A total of 15,342 out of 15,404 homes were included in the analysis. The findings indicated a substantial increase in COVID-19 cases from May. There was a fluctuation in cases among NH staff and residents between May and November.

Increased cases were identified through potential lapses in recommendations such as mask use adherence and social distancing. Staff members were involved in non-patient contacts, including social and household contacts. The study denotes the need to educate staff members in NHs on exposure within the community and strict adherence to the CDC guidance in all areas. The organizations have a role in ensuring adequate availability and easy access to PPEs. NHs' adherence to CMS regulations for testing staff members and isolation of new residents can reduce the risk of new outbreaks in NHs. Limitations of the report include data denoting aggregate data for a week without analysis on an individual patient basis. Reported data may not be valid due to missing data from several nursing homes. Sources of transmission and introduction of new COVID-19 cases

into NHs could not be identified. The generalizability of the results is restricted to NHs. The study calls for comprehensive infection control strategies to prevent infections into NHs and mitigate adverse outcomes.

Supporting Literature

Nurse Staffing and Coronavirus Infections in California Nursing homes (Harrington, 2020) aimed to examine the relationship between nurse staffing in California nursing homes and compare homes with and without COVID-19 residents. According to the Authors, 1.4 million nursing home residents have been severely impacted by the COVID-19 pandemic, with at least 25923 residents and 449 staff having died from the virus by 1st June 2020. The study also noted that most residents had chronic illnesses, and many shared rooms and congregated meals. They also acknowledged inadequate RN staffing levels and infection control procedures in many nursing homes before the virus outbreak. They obtained the study data from the California and Los Angeles Departments of Public Health and news organizations on nursing homes reporting COVID-19 infections between March and May 4, 2020. Their result showed that nursing homes with total RN staffing levels below the recommended minimum standard (0.75 hours per resident day) had a twice higher likelihood of having COVID-19 resident infections. They also established that Nursing homes with low RN and total staffing levels tend to leave residents vulnerable to the COVID-19 pandemic. The study then recommended a need to develop minimum staffing standards at federal and state levels to prevent vulnerability in the future.

The above research shows that there might be an association between nurse staffing hours and COVID-19 mortality. However, the study only compared the RN staffing levels with whether a nursing home has a COVID-19 resident or not. In addition, they failed to go deep into the analysis to assess how COVID-19 infections differ among nursing homes with different RN staffing hours. Therefore, further investigation is needed to investigate how RN and bot RN and LPN staffing hours influence COVID-19 mortality in Nursing homes.

Abuown et al. (2020) highlighted the impact of the second wave of COVVID-19 on staffing levels of health care workers in the United Kingdom. The NHs restructured its workforce after the coronavirus disease in 2019. The pandemic necessitated changes in NHs, including emergency rotas for COVID-19 with shadow covers to anticipated staff absences. The NHs redeployed healthcare workers from different cadres, including surgical, nonemergency, academic posts, and allied health professionals, to meet the heavy requirements of staffing levels associated with the COVID-19 response through the rotas. The study was published when the NHs anticipated the second peak of infections to provide expert opinions on whether the NHs will maintain adequate staffing levels to meet the health needs accruing from the second peak of infections. The authors surveyed 617 health care workers at St Mary's Hospital to better understand the impact of health care personnel's level during the pandemic.

Over 44 participants had been isolated over the past four months due to reported symptoms of COVID-19 infection. Eighteen percent of the isolated population were asymptomatic, while they had asymptomatic household members. The survey indicated

that the isolation periods were according to specified guidance (10-14 days). Over 48% of the surveyed participants resided with ≥1 healthcare worker in the same household. According to these findings, a positive swab in the study affected more than one household member (2 health care workers). In May, high antibody sensitivity was regarded as a turning pot for COVID-19 response, with many facilities rolling out widespread antibody tests for staff.

The authors indicate that discussion on immunity following the previous infection was speculative and remains reliant on research for clarifications. At the time of the study, the NHs advised isolation with a positive antibody test and the need to isolate when a household member becomes symptomatic. However, antibody testing did not stop the domino effect of health care workers' depletion if a second wave arises. The authors anticipated challenges with a new wave when the NHs were under immense pressure due to seasonal diseases. Abuown et al. (2020) indicated that health care workers needed to be extra prepared and vigilant for increasing self-isolation while waiting for the swab test. The test and test strategy adopted by the government was likely to face resistance with an increasing list of patients on the waiting list. The insight gained from the study is on the preparedness for waves of new infections after the first one on health care staffing, including appropriate use of data for health care workers who test positive in active duty and examining the possibility of workforce depletion and the need to maintain safe staffing levels of frontline health care workers.

Belmin et al. (2020) explored whether self-confinement of staff with residents in French nursing homes during the pandemic was associated with better COVID-19

outcomes related to national outcomes. After the outbreak in France, some nursing homes took the initiative to confine staff members and residents to reduce the risk of introducing SARS-CoV-2 from individuals outside the nursing homes. The cohort study encompassed a telephonic study investigating the occurrence of infections among staff and residents in the facility while simultaneously comparing the data with national surveys by French Health authorities. The study involved 17 NHs with self-confinement of staff and residents. The study objectives were to evaluate the COVID-19–related outcomes after voluntary confinement of staff with residents. The retrospective cohort was conducted between 1st March 2020 and 11th May 2020. Voluntary participants included staff from NHs who participated in the study and facilities for the elderly who did not practice self-confinement. COVID-19 rates and mortality cases based on self-confinement were compared with results from population-based nursing home surveys by health authorities in France. The primary exposure was self-confinement for a period of fewer than seven days.

The outcomes were COVID-19 cases for residents and staff and mortality among residents. Diagnosis of COVID-19 was made by the hospital or primary care physicians based on respiratory and fever signs of an illness compatible with COVID-19. Confirmation was done by reverse transcriptase PCR testing for SARS-CoV-2 based on nasopharyngeal swabs with positive results (Belmin et al., 2020). The cohort study findings indicated a lower incidence of COVID-19 among residents and lower mortality rates of residents for facilities that participated in nurse confinement. Self-confinement facilities reported lower COVID-19 cases among staff rates than the national survey. All

except one NHs recorded cases of infections underpinning efficacy in blocking the entry of SARS-CoV-2. Asymptomatic carriers could have contributed to outbreaks in the facility. The study limitations include the inability to establish a causal link between low incidences of SARS-CoV-2 and self-confinement. The size and type of NHs varied greatly and were geographically located in areas affected by the pandemic. Self-confinement initiatives highlight the dedication to residents and may have improved infection prevention and control procedures. SARS-CoV-2 cases may have been missed due to underreporting, negative results, and atypical presentations. The study suggests that self-confinement with staff members may protect staff members from COVID-19 infection.

Gorges and Konetzka (2021) examined the racial composition of COVID-19 death differences in nursing homes. Racial disparities in nursing home quality are a common phenomenon in the USA. Black individuals are more likely than whites to be admitted to the NHs with lower quality, lower staffing ratios, and deficiencies in regulatory adherence. This leads to disparities in the segregation of NHs. The disparities also extend to payment as NHs funded by public payers, and the proportion of Medicare coverage in patients is associated with differences in quality. The study examined the possibility of COVID-19 mortality disparities and data associations between NH quality and the number of COVID-19 deaths and infections. The study examined racial factors that had associations with coronavirus infection mortality among residents in nursing homes. The study also evaluated whether the association was attenuated when case mix, facility size, facility characteristics, and prevalence of COVID-19 in the community were

accounted for. The study included 13,312 NHs that submitted COVID-19 data to the CDC's website weekly. The website had complete information about the NHs' characteristics and past reviews on quality assurance. The study utilized publicly available data and was exempted from IRB review. The reporting guidelines for this cross-sectional study followed STORE guidelines. The Nursing Home Compare data and data from CDC's NHSN were merged. The CMS conducted quality reviews for nursing homes. The data analyzed was released on 4th December 2020.

The primary outcome was the count of self-reported COVID-19 deaths in a facility from 1st January-24th May 2020 to 13th September 2020. The researcher examined the total number of confirmed (diagnostic laboratory test) and suspected cases (symptomatic) in that period. The number of facility-level deaths was calculated per 100 cases. The population of non-Hispanic Whites was grouped into five quintiles (racial compositions), while Whites' data was based on self-reported data. The authors utilized alternative categorization to assess differences in other groups. Case-mix was assessed using the proportion of residents with hypertension and acuity index (cognitive/functional impairments among residents). The authors-controlled characteristics of nursing homes - nursing homeownership (government, nonprofit or for-profit), payer mix (Medicare and Medicaid), certified number of beds (facility size), Nursing Home compare 5-star rating, chain membership, and nursing hours (hours/resident day).

Community spread was measured as confirmed cases outside NHs per 1000 people in a county. Statistical analyses entailed unadjusted means for nursing home characteristics via racial composition followed by regression models for effects of

quantiles on deaths and later adjusting for characteristics- county-level rates of COVID-19 infections, case mix, number of beds, and other characteristics. Analyses also involved stratification to divide the sample of nursing homes into five groups based on Nursing Home Compare ratings. The Strata software (ver. 15.1) was used for statistical analyses. The mean age of residents among the 13,312 NHs was 79.5 years.

A total of 51,606 COVID-19-associated deaths were recorded. The mean of deaths reported was 3.9 deaths per facility. The mean number of deaths in nursing homes with the lowest percentage of White residents was 5.6 compared to NHs with the highest percentages of Whites which was 1.7. Quintile 1 facilities (3.9) had more average deaths than quintile 5, which translates to a 3.3-fold increase in deaths in the first quintile compared to quintile number five. The adjustments for certified bed numbers reduced differences between quintiles 1 and 5 to an average of 2.2 deaths. Case-mix control measures did not modify the association. Adjusting the county-level prevalence of COVID-19 cases reduced the difference to an average of 1.0 death. However, the study highlighted that racial disparities account for associated COVID-19 deaths in nursing homes. Historically, racial disparities cause disparities in health care in nursing homes. The worse outcomes were associated with NHs with more significant percentages of non-White residents. The composition of residents also determines the quality of care in NHs, including staffing levels. The study highlighted disparities in nursing home residents' composition and how non-White communities are disproportionately affected by the high spread of the disease and worse outcomes.

Study limitations of the study include failure to highlight individual-level COVID-19 data, which could further highlight the disparities. First, the cases and deaths were facility-level self-reported data. Individual-level data could offer valuable insight into interfacility and inter-facility differences in the study. The authors call for individual-level data on cases to understand the impact of individual-level factors associated with coronavirus infections' outcomes, such as mortality disproportionality. Second, data were based on racial classification under Hispanic, White, and Black. The study did not detail diverse ethnicity, races, and minorities to examine differences in outcomes. Third, the cases of infections and deaths were self-reported, and the count for the study was initiated in May, omitting several cases in the final analysis. Fourth, the case-mix variables failed to capture all variables relevant to health aspects. Finally, the methodology (cross-sectional observation) failed to highlight causal associations.

Ouslander and Grabowski (2020) reiterate that the pandemic put nursing homes in crisis due to a vulnerable population with atypical manifestations of COVID-19 and inadequate resources to curtail the spread of the infection PPEs, accurate diagnostic testing materials, and effective therapies for COVID-19 infections. As a result, viral infections are more prevalent in nursing homes. The data being reported undermines the pandemic's magnitude in nursing homes. An estimated twenty-one percent of nursing homes had reported at least a single case of COVID-19 infection. The CDC indicated over 142,231 confirmed cases, 90,600 suspected cases, and 38,518 deaths associated with the viral illness on 12th July 2020.

Ouslander and Grabowski (2020) described it as a perfect storm that will continue to present a challenge as normalcy returns. As the masses reopen, more infections among staff and health care providers will be found outside nursing homes. They may remain asymptomatic and spread the virus unknowingly at their workplaces. Thus, the designation perfect storm. A single person can spread the infection and cause several deaths within a nursing home. The pandemic has devastatingly affected nursing homes, staff, residents, clinicians, and immediate families. Rapid spread, multiple COVID-19 cases, and related deaths remain challenging for nursing homes.

Effective infection control procedures are essential in the prevention of the virus. However, it is challenging for facilities with space constraints and double rooms. Selection of quarantine/isolation rooms may be impossible in such facilities, posing a challenge for suspected cases. In addition, there are several negative impacts on mood, function, and cognition among nursing home residents and staff in isolation cases. It can also cause emotional trauma and anxiety for patient families. Thus, a significant determinant of virus acquisition apart from nursing home quality is compliance with infection prevention and control measures. The authors highlight that even high-quality nursing homes can have several cases of serious illness, infection clusters, and high mortality cases (Ouslander & Grabowski, 2020).

The authors propose several approaches for calming the storm, including clinical, policy, and public health initiatives. Public health measures entail maintaining recommended infection prevention and management education and emergency preparedness, screening all individuals who enter nursing homes, including staff, slow

but careful NH reopening strategy, quarantining/isolating hospital admissions, and regular laboratory diagnosis nursing homes' staff. In health policy, the author's proposed initiatives to contain the spread of the virus include addressing diversity and disparities in virus acquisition, reimbursing clinicians to offer telemedicine services, complying with CMS regulations on efficiency, quality, and transparency, and ensuring sufficient surveys to ensure compliance with federal regulations. To calm the storm, required resources are access and availability of rapid tests, adequate PPEs, and staffing plans to meet the high demands. Back-up plans include replacing staff who are suspected cases or those who test positive for the virus. Resource sharing, strong communication, and collaboration strengthen the health system. Ouslander & Grabowski (2020) reiterate that the pandemic has exposed the health care system and nursing homes' ability to handle a crisis. The crisis presents an opportunity to improve the industry by including more nursing home staffing. Minimum staffing recommendations are more important than ever to address the widespread shortages in the country. Additionally, it is critical to ensure providers have benefits such as non-punitive sick leaves and full insurance covers.

Definitions

Covid Mortality - Covid Mortality is the number of deaths reported due to COVID 19 (Nogueira, 2020)

Registered Nurse (RN) - Registered nurses assist doctors in administering medication and treatments and offering educational advice to patients and the public (Novotny et al., 2018).

Licensed Practical Nurse (LPN) - Licensed Practice nurses work alongside the primary care providers to offer more basic nursing care and are responsible for the patient's comfort (Novotny et al., 2018).

Nursing Home - Nursing homes are health care facilities offering care and support for people with specific conditions or different types of disabilities who battle daily needs and require added support (Nogueira, 2020).

Descriptive Research Design - Descriptive Research Design is a research design that employs surveys to gather data about the subject matter to identify the extent to which different conditions can be obtained among these subjects (Siedlecki, 2020).

Assumptions

The study assumes that Nursing home staff are empowered and held accountable for achieving the standard. All nursing homes strictly follow the COVID-19 guidelines from the Indiana State Department of Health, the Government of the USA, and the World Health Organization. It also posits that the information reported by the nursing homes to CMS is the true situation in the nursing homes and that no nursing home reported incorrect data and that CMS and the Indiana department of health regularly conduct monitoring of the nursing homes to confirm the state of the nursing homes against the information provided.

Scope and Delimitations

The study examines the relationship between nurse staffing level and covid mortality. This study will focus on how LPN staffing hours influence COVID-19 mortality, how RN nursing hours influence COVID-19, and how combining the two

nurse staffing hours influences COVID-19 mortality. The study will only include nursing homes reporting COVID-19 infections and are located within Indiana State. The generalization of this study is on the relationship between nurse staffing hours and COVID-19 deaths.

Limitations of the Study

Limitations of this study include that the study cannot verify the data obtained to ascertain that the data reflects the actual situation in the nursing homes. This study does not consider other factors contributing to high COVID-19 mortalities in a nursing home. For example, nursing homes with many residents suffering from severe chronic diseases may likely record more deaths. The study only focuses on nursing homes; therefore, it is difficult to generalize the finding to other caregivers.

Significance of the Study

This study is significant because it will explain the necessity of staffing hours per day, staffing levels, and staffing capacity in the middle of a pandemic. The study will also inform workforce relationships by addressing staffing characteristics such as staffing shortages at each nursing level and long working hours to provide quality care and reduce infections within the nursing home. Therefore, this study intends to inform the relevant bodies of staffing capacity in the fight against the COVID-19 pandemic. The long-term significance of the study will be reduced COVID-19 deaths in the nursing homes and improved care to the nursing home residents due to improved nurse staffing in the nursing homes. Therefore, this study will bring positive social change to society by helping develop a procedure for fighting COVID-19 mortality and a blueprint for

consideration in the other diseases related to COVID-19 and in case of any future pandemic. This will also improve society's confidence in the care provided by Nursing homes.

Summary

This chapter has successfully outlined several aspects important in reviewing nursing home situations. First, the study discusses the Problem Statement, Purpose of the Study, Research Question(s) and Hypotheses, theoretical and Conceptual Framework, and the study's nature. Second, the chapter also reviewed the literature of past studies to find out what has been done and what still needs to be done. Finally, this chapter provides us with some definitions of terms used in the study, assumptions in the scope and delimitations, and the significance of the study. In the next chapter, I will focus on the design and rationale the study will employ to make sure that I meet the purpose of the study

Section 2: Research Design and Data Collection

The purpose of this quantitative study was to evaluate the relationship between RN and LPN staffing hours and COVID-19 deaths in Indiana State private and public nursing home residents based on the data obtained in the Care Compare database and Indiana Department of health COVID-19 portals. This chapter discusses the research design rationale where I state study variables, identify the research design used and state how it is linked to the research questions, and explain critical constraints linked to the design. I also describe the study's methodology and define the target population. I will also discuss the instrumentation and operationalization of the survey constructs. This chapter also details the analysis plan, including the statistical software used, the data cleaning process, the analysis elements such as statistical tests, the rationale for potential covariates and/or confounding variables, and how results were interpreted. Other sections of this chapter include threats to validity and ethical procedures.

Research Design and Rationale

The research design is intended to offer a suitable structure for a study, establishing how information for the study will be acquired (Leavy, 2017). I employed a cross-sectional study design to understand the Indiana nursing home situation regarding COVID-19 deaths. The dependent variable was COVID-19 deaths, and the independent variables were RN and LPN staffing hours per patient per day. I acquired data on the COVID-19 mortalities across the nursing homes in Indiana. Then I acquired data describing RN nurses' staffing hours per patient and the LPN staffing hours per patient. I

ran descriptive statistics to see how these three compared. Next, I ran a regression analysis to assess the relationship between nurse staffing hours and COVID-19 mortality.

The significant constraints consistent with the design are that the design was expensive due to acquiring data and software, requiring relevant statistical analysis skills (Leavy, 2017). In addition, the research design is also time-consuming since obtaining data, organizing, cleaning, and analysis take time. Thus, I used a descriptive research design for an accurate sample population profile and relevant characteristics of the phenomenon of interest in nursing homes. This design enabled me to obtain relevant data from a range of nursing necessary for assessing the relationship between the staffing level and COVID-19 mortality in Indiana and use the inferential statistic to analyze how RN and LPN staffing hours can influence the rate of COVID-19 mortality in the nursing homes.

Methodology

Population

The target population is the population of people living in Indiana and the population of nursing homes in Indiana. They take an interest in the residents of Indiana since everyone is vulnerable to COVID-19. The nursing homes were the main target of interest since the survey focused on the number of deaths due to COVID-19 in the nursing homes and nurse staffing levels in the nursing homes.

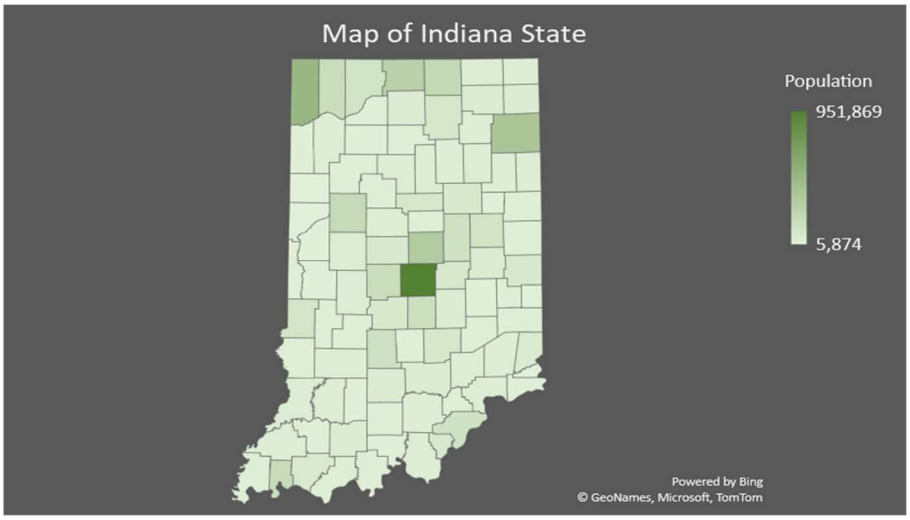
Indiana Population

According to the U.S. Census Bureau, Indiana's population is estimated to be 6,732,219, based on 2019 population estimates. The median age of the Indiana population

is 37.8. Native-born citizens are younger than foreign-born residents, with a median age of 38 and 40 years; persons above 65 years form 16% of the Indiana population. Indiana's population is divided into 92 counties, with the most populated county being Marion County, with a population of 951,869, whereas Ohio County has the least populated population of 5,874 persons. Most Indiana residents (96.9%) are U.S. citizens, and 5.11% of the residents of Indiana are reported to have been born outside the United States. The dominant race is White (non-Hispanic), equaling 5.27 million, Black or African Americans are the second dominant race with a population of 629,000 persons, and Hispanic residents are the third dominant race with a population of 274,000 persons. Besides English, other common languages in Indiana are Spanish, German, Yiddish, Pennsylvania Dutch, and other West Germanic Languages. Figure 1 shows Indiana's map and how populations are distributed across different counties.

Figure 1

Map of Indiana

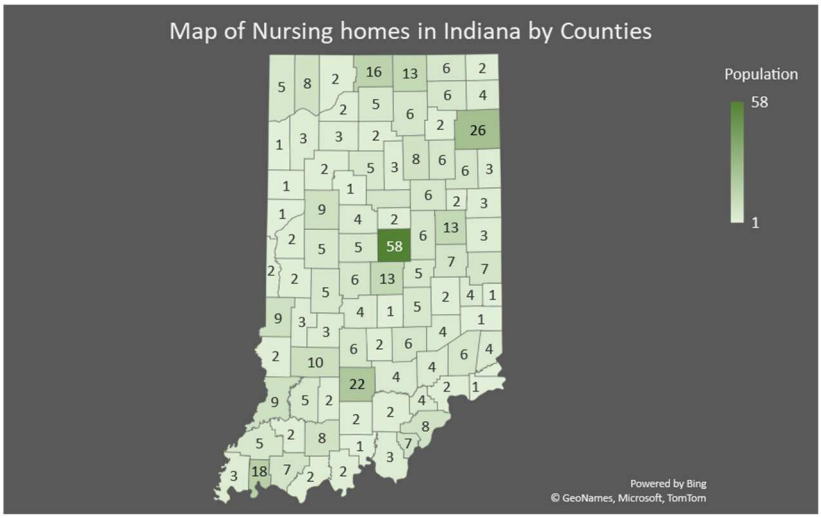


Nursing Homes in Indiana

According to the Indiana Care Planning Council, around 530 nursing homes in Indiana are distributed across different counties. These nursing homes are distributed across counties in Indiana, as shown in the map in Figure 2.

Figure 2

Map of Nursing Homes by Indiana County



According to the council, nursing homes act as a cost-effective alternative to make it possible for patients with injuries, severe illnesses, or postoperative care who need to recover in an environment outside the hospital (Ingov, 2021-b). These sectors also serve a second purpose in taking care of the patients suffering from chronic diseases and those in need of long-term care. The council also noted that nursing homes are usually the last stop for the long-term care process for many patients receiving chronic care. These patients view it as an evolving process of losing more physical and mental capacity. Because of these purposes, nursing homes are usually equipped to take care of

medical issues, disabilities, and in certain instances, behavior complications that any other providers cannot take care of.

The council also observed that about 91% of all nursing home residents are aged 65 years and above, implying that nursing homes are more attractive to the elderly (Centers for Medicare and Medicaid Services, n.d.-b). In addition, 98% of these residents also use Medicare as their primary insurance. Based on the information, it is evident that nursing home attracts many people who need close attention due to their needs. Besides these groups of people forming, most nursing home residents are also in the bracket at high risk of severe COVID-19 effects. Therefore, I conducted this study on nursing homes, intending to advise on what needs to be done to ensure that the people depending on nursing homes for their primary care are prevented from the dangers of COVID-19.

Sampling and Sampling Procedures

Sampling

I obtained secondary data from Nursing Home Care Compare on RN and LPN staffing hours per patient per day (Centers for Medicare and Medicaid Services, n.d.-b). I also obtained data from the Indiana State Department of Health COVID-19 portal on COVID-19 mortality (Centers for Medicare and Medicaid Services, n.d.-a). In these datasets, the critical data points that I applied in the research are the RN staffing hours per patient per day and LPN staffing hours per patient per day from the nursing home compare dataset. In addition, in the COVID-19 dataset, I obtained COVID-19 mortality per nursing home data point.

Determine Sample Size using Power Analysis

The calculated sample size confines the marginal mean outcome of treatment within a prespecified margin of error (Gosh, 2020). Because in this study, I desired to obtain 80% power, I calculated the desired sample size as follows:

Desired sample size = (Z-score)2 * P * (1 - P) / (margin of error)2

P is the power of the study = 0.82, Confidence level = 95%, Z score for 95% confidence level (Zα/2) = 1.96, and Margin of error =10% of the P= 0.08. Based on this formula, I needed a sample of 96 nursing homes to obtain 80% power. However, considering that COVID-19 mortality has not been subjected to several investigations, the distribution is unknown, and it is ideal to use a large sample size as large as possible. Since I had access to the data from all nursing homes in Indiana, it was more efficient to use the whole data set instead of having a random sample.

Sampling Inclusion and Exclusion Criteria

The following factors were used to determine the inclusion and exclusion of the target population in the data. These criteria were based on the date; the data must be from the latest reported. For example, the April 2021 cycle for care compares the dataset and the 9th May 2021 for COVID-19 mortality data. Another aspect was the exposure of interest; the nursing home facility must have been exposed to the dangers of COVID-19. In terms of location, the facility must be located within Indiana. Any facility outside Indiana state is not eligible for inclusion in this survey. I also chose all nursing home facilities that are admitting COVID-19 patients.

Procedure for Gaining Access to the Data Set

I employed the Raw datasets from Care Compare (CMS.gov, 2021) and the Indiana Department of health COVID-19 portal (Ingov, 2021-a) records in the study. These data were collected and submitted to these entities by CMS. CMS data were open-source data; therefore, the datasets were available for access to the public. However, before access to the Dataset, the only permission required was to log in to the website with a valid email, email verification, and indication of data and demographics of interest. The data was downloaded and saved in Excel format.

Reputability of the Sources and Justification

The data sources were official institutes mandated by Indiana state and the Federal government of the United States of America to collect and verify medical data on behalf of the state. In addition, the sites gave access to data and research works on behalf of the US government. The most significant aim was to drive the US government's mission of making States' data readily available in open, accessible, and machine-readable formats.

Regarding quality-of-care Data, Care Compare data represented the best data source since it gives access to the care quality data from CMS. It compared the qualities of different care providers, in this case, nursing homes, to make it easy for consumers of medical services to decide on which facility to go to.

Indiana Department of Health was the government's wing in charge of health-related issues. The department had a COVID-19 control unit mandated with tracing and controlling the COVID-19 pandemic situation in Indiana. The data from CMS aided the

department of health COVID-19 control unit by obtaining valuable data that can be used to assess nursing homes' situations.

These sites were the best to obtain data from because they were intended to be used by the government to ensure improved quality care in the USA. Besides that, the sites also employed numerous quality checks to ensure that the raw datasets are as accurate as possible. Therefore, they also contained the most UpToDate data about COVID-19 and other health care quality performance indicators such as staffing levels.

Operationalization of Constructs

In this research, I investigated the associations between COVID-19 mortality and nurse staffing, which cannot be directly observed and measured. Therefore, to measure these variables, I could only measure the indicators related to the LPN nurse staffing hours, RN nurse staffing hours, and COVID-19 mortality. The table below summarized the operationalization of the variables.

While the study assumed residents' age or pre-existing ailments as contributing factors in the patient outcomes (dependent variable), it sub-divided the nursing homes based on ownership type, location, and provider type to expound on the such factors' influence on the dependent variables. I indirectly linked staffing hours to these concepts to help me expound on the recommendation I offer to all nursing homes irrespective of ownership, location, or provider type.

Table 1

Variable Operationalization

Variable	Description	Measure

COVID-19 mortality	Total number of deaths reported due to COVID-19 infection	Nominal; Total number of deaths due to COVID-19
RN staffing hours per patient per day	The average number of hours that Registered nurses (RN) take when caring for one patient in a day	Ratio: (total number of hours attending to patients divided by the number of working hours per day) divided by the number of patients in the facility.
LPN staffing hours per patient per day	The average number of hours that Licensed Practice Nurses (LPN) take when caring for one patient in a day	Ratio: (total number of hours attending to patients divided by the number of working hours per day) divided by the number of patients in the facility.

Restating the Research Questions and Hypotheses

The research questions that the study is sought to answer and the following hypotheses for each research question:

What is the relationship between RN staffing hours and COVID-19 deaths in Indiana State's private and public Nursing home residents based on the data obtained in the Care Compare database and Indiana Department of health COVID-19 portals adjusting for nursing home size, ownership type, and rural location?

H0: RN staffing hours have no statistically significant relationship with COVID-19 deaths in Indiana State Private and Public Nursing homes.

H1: RN staffing hours have a statistically significant relationship with COVID-19 deaths in Indiana State Private and Public Nursing homes.

What is the relationship between LPN staffing hours and COVID-19 deaths in Indiana State private and public Nursing home residents based on the data obtained in the Care Compare database and Indiana Department of health COVID-19 portals adjusting for nursing home size, ownership type, and rural location?

H0: LPN staffing hours have no statistically significant relationship with COVID-19 deaths in Indiana State Private and Public Nursing homes.

H1: LPN staffing hours have a statistically significant relationship with COVID-19 deaths in Indiana State Private and Public Nursing homes.

Data Analysis Plan

This section explains the processes undertaken to collect, clean, and analyze the data to obtain the outcome relevant to this study's research questions. The section describes the software applied, data cleaning and processing, research questions and hypotheses, and how the data will be analyzed and interpreted.

I applied Microsoft Excel software and Statistical Package for the Social Sciences (SPSS) to aid data cleaning and analysis in this study. The data obtained are expected to be of high quality since the sites apply data quality checks to ensure that any inaccurate entry is discovered and flagged for Correction. However, the study acknowledged that there is still room for having an erroneous entry. Therefore, this survey employed data cleaning techniques such as checking for wrong entries and outliers and applying relevant corrective measures. Some of the data cleaning activities I carried out are:

- Checking and removing duplicates in the data
- Fixing structural errors such as wrong entries, e.g., having an unfavorable COVID-19 mortality
- Identifying and removing outliers
- Looking for and correcting missing values
- Checking for validation issues to make sure the data made making sense

This study employed descriptive data analysis design. The study ran descriptive statistics for the three variables, COVID-19 mortality, RN staffing hours per patient per day, and LPN staffing hours per patient per day. The study also applied cross-tabulation between the independent variables, RN staffing hours per patient per day and LPN staffing hours per patient per day, and the Dependent variable, COVID-19 mortality.

Descriptive analysis was meant to get an insight into the distribution of the data points. Cross tabulation was critical in showing the hypothetical association between COVID-19 mortality and the two types of nurse staffing hours. The study applied Multiple Linear Regression to model the mortalities in nursing homes, which is a discrete outcome. The study will be conducted at a significant level of 0.05. Upon obtaining the regression outcome, p-values for the coefficients will be compared with a 0.05 significant level. The decision rule 1 was: Reject the null hypothesis if the p-value is less than or equal to 0.05. Otherwise, fail to reject the null hypothesis.

Multiple Linear Regression

In most cases, researchers use a linear regression model to model response variable because many phenomena surrounding us can be assumed to be normally distributed. Multiple Linear regression, also known as multiple regression, is an analysis technique that enables us to model several explanatory variables to predict a response variable. Like in this case, I had two explanatory variables, RN and LPN, which I need to model to try and predict how they influence COVID-19 mortality.

Multiple regression models can be expressed using the equation below.

$$\hat{Y} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n$$

Where

Yˆ is the estimate of the response variable

β_0 is the intercept of the model (value of response variable given all the explanatory variables are at zero)

β_is are the coefficients of the explanatory variables

X_is are the explanatory variables

Fitting the variables to the model, I obtain:

(Covid-19 mortality)ˆ=β_0+β_1 RN+β_2 LPN

Where β_1 and β_2 are the coefficients of RN and LPN nurse staffing hours per patient per day, respectively.

My study tested the assumptions below to ensure they are met before continuing with multiple regression:

- Linear relationship: Dependent variables and independent variables exhibit a linear relationship
- Independence: an observation in the sample is independently obtained from other observations.
- Homoscedasticity: Constant variance of the observations
- Normality of the residuals: Error between predicted and observed values should be normally distributed.
- No multi-collinearity: No high correlation between independent variables

Threats to Validity

In this segment, I described possible threats to the external validity of the study design and how I addressed the threats, internal validity and how they are addressed, and threats to statistical conclusion validity.

Threats to External Validity

To address explanatory variables' interaction with other variables like variation in climatic conditions or state of living might lead to false external validity, I selected a specific state, Indiana, with no considerable variation of factors. Living status in nursing homes is also approximately the same. Setting these factors at an almost fixed level helped in addressing this threat. Interaction between selection bias and independent variables was addressed by having a dataset for all the nursing homes in Indiana to avert the chances of selection bias. By eliminating selection bias, I ensured that this threat was eliminated. Interference is due to multiple independent variables, making it hard to control other variables' effects. To address this, the study ensured that the independent variables included minimizes this interference. In addition, having only two independent variables will make it easier for the study to account for the effects of each variable.

Threats to Internal Validity

Data obtained at different time durations may threaten internal validity since there might be events between the time for the first data collection and the other. To address this, the study ensured that the period between the latest staffing hours reports and the collection date for COVID-19 mortality is concise. Thus, no significant change can have happened to change staffing hours. Data obtained over a long period can result in changes

regardless of levels of independent variables. My study addressed this by ensuring the time remains as short as possible to avoid variation.

Statistical regression: regression selects subjects based on extreme characteristics, thus bringing significant influence even if there is none. This threat is reduced by selecting the Poisson regression model that gives outcomes closer to observed values than the normal regression.

Bias during reporting: there is a risk of nursing homes reporting false figures to show that they are doing well. The selection of data sources, however, reduces this threat. CMS has implemented several quality checks that ensure any inconsistency is flagged and corrected. Besides that, the data cleaning process will also help to minimize this threat to the validity

Threats to Construct or Statistical Conclusion Validity

When the relationship is present, there is a threat of not finding the relationship between staffing hours and COVID-19 mortality. This may be because not properly testing the assumption or selecting a significant level leaves a more considerable margin of error.

Ethical Procedures

The study is compliant with several ethical procedures, which include agreement to gain access to secondary data. The study accessed secondary data from CMS, a government institution. The data by CMS are approved by the government of the USA and are free to be accessed by anyone. I also forwarded the request to use the secondary data to the University panel, and the datasets were approved to be suitable for use

The datasets ensured that they maintained the anonymity of the human participants. The quality measurements available are only nursing home descriptions and measures of quality assurances. These include the number of deficiencies reported, types of deficiencies reported, staffing levels, COVID mortality, COVID tests, and COVID deaths. The research questions for the study are straightforward, and methodologies and justification are all well elaborated to prove that the study is not intended to create any harm but to offer a solution for the problems faced by nursing homes

Next, the secondary data obtained met all ethical requirements during data collection. The nursing homes present the reports willingly with no coercion from authorities or the Centre for Medicare and Medicaid Services, the authorized data collectors. Study data also meets anonymity and security requirements since no personal information is shared in the data for any human respondent; the data is to be used strictly for this research and not promote any other activity outside this study.

Summary

This section looked at the research design rationale and methodology employed in the study. The study employed a descriptive research design involving obtaining secondary data and running descriptive and inferential analyses. Under methodology, it is stated that the study will use Excel and SPSS for analysis. The target population is nursing homes in Indiana. The data sources were Nursing Home Care Compare data and the Indiana State Department of Heath COVID-19 portal, whose data are all provided by CMS. CMS data sources are open-source and do not require. The chapter also highlighted date, exposure of interest, study geographic location, study design, and participants as

factors that will inform sampling inclusion/exclusion. The variable operationalization also included the total number of deaths reported due to COVID-19 infection for the dependent variable, the average number of hours that RNs take when caring for one patient in a day, and the average number of hours that LPNs take when caring for one patient in a day. Upon receiving data, the study will clean data before running descriptive statistics, cross-tabulation, and Poisson regression analysis as an inferential analysis technique. This chapter also highlights threats to internal and external validity, how they will be addressed, and threats to construct or statistical conclusion validity.

Section 3: Presentation of the Results and Findings

The purpose of this study was to investigate if nurse staffing hours have any significant effect on COVID-19 mortalities in Indiana state nursing homes. To establish this relationship, the study was intended to answer the following research questions:

1. Is there an association between RN staffing hours and COVID-19 deaths in Indiana State private and public nursing home residents based on the data obtained in the Care Compare database and Indiana Department of Health COVID-19 portals adjusting for nursing home size, ownership type, and rural location?
2. Is there an association between LPN staffing hours and COVID-19 deaths in Indiana State private and public nursing home residents based on the data obtained in the Care Compare database and Indiana Department of Health COVID-19 portals adjusting for nursing home size, ownership type, and rural location?

This section reports the analysis results as outlined in the previous chapter.

Data Collection of Secondary Data Set

The study employed raw datasets from Care Compare and Indiana Department of health COVID-19 portal records. These data are collected and submitted to these entities by CMS (Centers for Medicare and Medicaid Services, n.d.). The data were collected and submitted to CMS between March 2021 and 9th May 2021. There are a few discrepancies in the datasets collected from CMS. First, the datasets are based on the reports submitted by nursing homes. This implies that there are limited ways to confirm whether the

information provided is the actual state of occurrences in the nursing homes or if some nursing homes have been misreported. Some nursing homes failed to report all the needed variables; for instance, only 530 out of 533 reported COVID-19 deaths. The data are collected across all the nursing homes in Indiana, with key demographics like facility type, county of location, and ownership type also noted. Since I used the census data set for all the nursing home facilities, the study has no concerns about how the sample represents the population.

Descriptive Statistics

Table 2 shows the quantitative descriptions of the data to aid in comparison between variables. The total number of valid observations varied across all the variables, implying that the analysis summarized the data list-wise and approved at least 501 nursing homes based on the data present. I also assessed demographics like facility type, county of location, and ownership type (see Tables 3–5).

Table 2

Descriptive Statistics for Variables

Descriptive Statistics					
	N	Sum	Mean		SD
	Statistic	Statistic	Statistic	Std. Error	Statistic
Rural	533	390.0	.732	.0192	.4435
Ownership Type Variable	533	1287	2.41	.086	1.982
Provider Type Variable	533	24	.05	.011	.256
Reported LPN Staffing Hours per Resident per Day	525	466.77743	.8890999	.01320655	.30260010
Reported RN Staffing Hours per Resident per Day	525	371.91321	.7084061	.01996941	.45755661
Total Resident COVID-19 Deaths Per 1,000 Residents	508	90185.5	177.531	9.1689	206.6569
Valid N (listwise)	501				

Table 3

Distribution of Nursing Homes by Ownership

Ownership Type	Frequency	Percent
For profit – Corporation	225	42.2
Non-profit – Corporation	111	20.8
Government – County	105	19.7
Non-profit – Other	26	4.9
Government - City/county	25	4.7
For profit – Individual	13	2.4
Non-profit - Church related	12	2.3
For profit – Partnership	6	1.1
For profit - Limited Liability company	4	0.8
Government - Hospital district	3	0.6
Government – City	2	0.4
Government – State	1	0.2

Based on the data from Table 3, for-profit corporation-owned nursing homes are the most in Indiana, and government state owned facilities are the least, accounting for 42.2% and 0.2%, respectively. In essence, more than 63% of the nursing homes in Indiana belonged to for-profit and non-profit corporations. Under provider type, more than 96% of the nursing homes are Medicare and Medicaid-funded facilities. Facilities with only Medicaid or Medicare account for 1.1% and 2.3%, respectively (see Table 4).

Table 4

Facility Type

Provider Type	Frequency	Percent
Medicaid	6	1.1
Medicare	12	2.3
Medicare and Medicaid	515	96.6
Total	533	100

Based on the identified ownership types, the average COVID-19 deaths per 1000 residents was highest in government, state-owned facilities with a mean of 288.3, followed by for-profit partnerships. For-profit corporations recorded the least mean deaths, followed by government city-owned facilities at 54 and 68.9, respectively.

Table 5

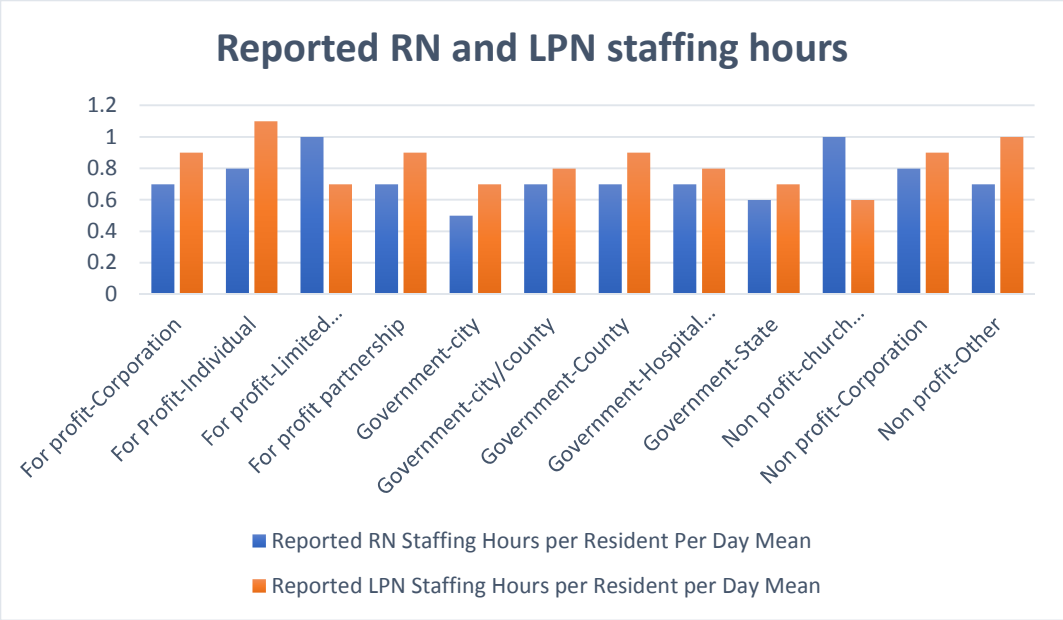
COVID-19 Situation in Nursing Homes by Ownership Type

Ownership Type	Total Resident COVID-19 Deaths Per 1,000 Residents
	Mean
For profit – Corporation	173.48
For profit – Individual	172.18
For profit - Limited Liability company	54
For profit – Partnership	203.02
Government – City	68.9
Government - City/county	276.5
Government – County	154.29
Government - Hospital district	135.25
Government – State	288.3
Non-profit - Church related	160.33
Non-profit – Corporation	196.06
Non-profit – Other	165.67

Figure 3 also includes the information for different ownership types. From the data, the disparity between RN and LPN staffing hours is greatest in for-profit individuals, non-profit church-related, non-profit other, and for-profit limited liability. The data for government county, non-profit corporation, government city/state, and government state are close to even.

Figure 3

Reported RN and LPN Staffing Hours



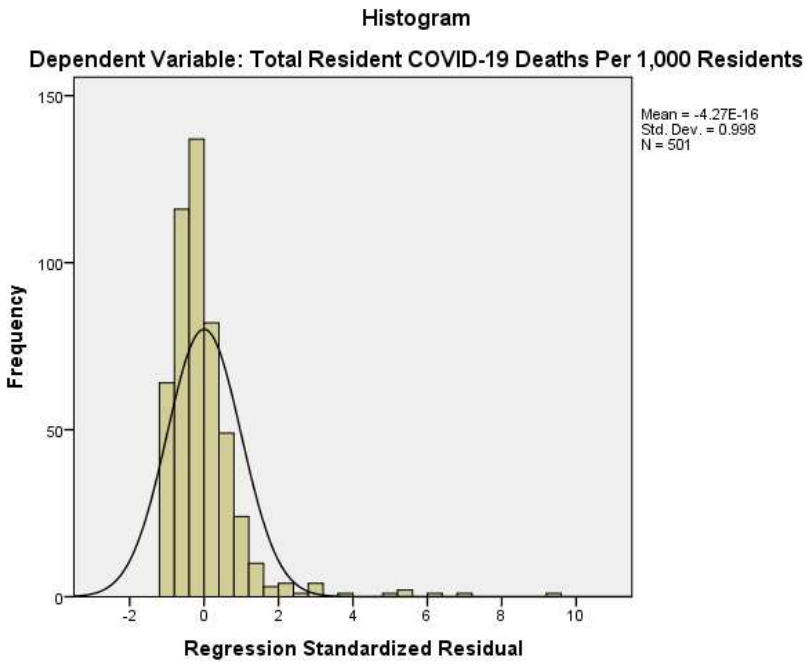
Summary of the Assumptions of Multiple Linear Regression Analysis

Testing for Linear Relationship and Normality

The histogram bars beyond the standardized residuals show a slight positive skewness as the right distribution stretches outside the curve with tiny bars protruding. Consequently, the positive kurtosis or leptokurtic distribution above the normal curve slightly deviates from the normality. In essence, the residuals are roughly normally distributed despite the slight deviations, and RN and LPN staffing hours have a linear relationship with COVID-19 deaths.

Figure 4

Regression Standardized Residual and COVID-19 Deaths

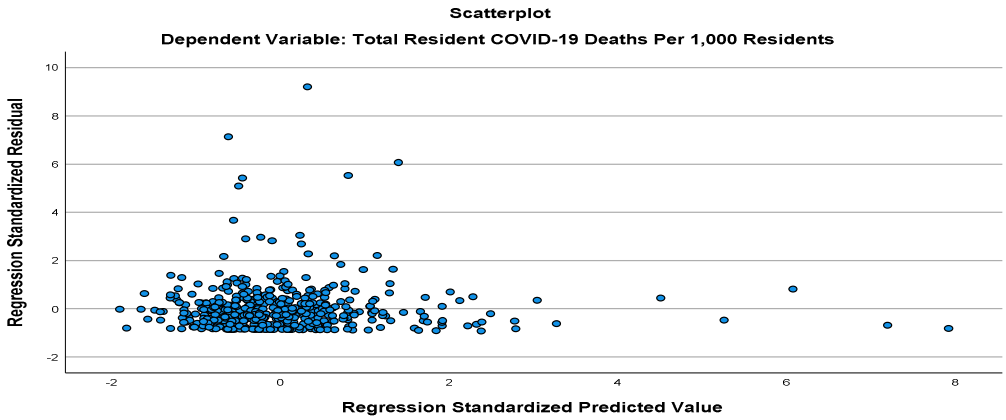


Homoscedasticity and the Linearity Assumptions

If the assumptions of homoscedasticity and linear relationships hold, the scatterplot should not have a defined and systematic pattern. Figure 4 seems to uphold the case, indicating variables' homoscedasticity and linearity assumptions.

Figure 5

Homoscedasticity and Linear Relationships for COVID-19 Deaths



Multiple Linear Regression

To ensure the study only determines the influence of independent variables on the dependent variable, I included possible control or confounding variables into the analysis to determine their effect and make necessary adjustments for nominal and ordinal variables. After conducting a hierarchical multiple linear regression, I determined that the confounding variables account for less than 1% of the influence of RN and LPN nurse staffing hours on COVID-19 outcomes. I can deduce this from the table by looking at the value of R-squared change before and after change statistics. Before change statistics, the value of R-square depicts the collective influence of independent and control variables. However, the values in change statistics denote the influence of only the independent variables (RN and LPN staffing hours) on the dependent variable. From the data, my adjusted R-square is 0.035 with an R-square of 0.463, implying that the linear regression explains more than 46% of the variance in the data. I have N-value (total observations)

because I used the "exclude list-wise" option to rank only the facilities with data in all the sections.

Table 6

Model Summary

Model Summary

Model	R	R^2	Adjusted R^2	SE of the Estimate	Change Statistics					Durbin-Watson
					R^2 Change	F Change	df1	df2	Sig. F Change	
1	.069[a]	.460	-.002	207.6620	.46	.797	4	496	.528	2.061

Note. a. Predictors: (Constant), Reported RN Staffing Hours per Resident per Day, Reported LPN Staffing Hours per Resident per Day, Reported Nurse Aide Staffing Hours per Resident per Day, Number of Certified Beds.
b. Dependent Variable: Total Resident COVID-19 Deaths Per 1,000 Residents

The f-ratio in the ANOVA table depicts whether the overall regression model is a good fit statistically for the data. The table F (2, 505) = 2.1169, p =0.00738, implying that statistically, the independent variables (RN and LPN staffing hours) predict the dependent variable (COVID-19 deaths).

Table 7

ANOVA

	Df	SS	MS	F	Significance F
Regression	2	10015.99	5007.994	2.1169	0.00738
Residual	505	21642479	42856.39		
Total	507	21652495			

After adjusting for the control variables, I only focus on the simultaneous coefficient variables, which are the initial independent variables for the study. Positive covariance and correlations imply that an increase in RN staffing hours increases LPN

staffing hours. However, the reverse is also true for COVID-19 deaths. A decrease in staffing hours translates to an increase in COVID-19 deaths.

Table 8

Coefficient Correlations

Coefficient Correlations[a]				
Model			Reported RN Staffing Hours per Resident per Day	Reported LPN Staffing Hours per Resident per Day
1	Correlations	Reported RN Staffing Hours per Resident per Day	1.000	.058
		Reported LPN Staffing Hours per Resident per Day	.058	1.000
	Covariances	Reported RN Staffing Hours per Resident per Day	490.546	39.368
		Reported LPN Staffing Hours per Resident per Day	39.368	938.234

Note. a. Dependent Variable: Total Resident COVID-19 Deaths Per 1,000 Residents

Table 9

Collinearity Diagnostics

Collinearity Diagnostics[a]						
Model	Dimension	Eigenvalue	Condition Index	Variance Proportions		
				(Constant)	Reported LPN Staffing Hours per Resident per Day	Reported RN Staffing Hours per Resident per Day
1	1	2.739	1.000	.01	.01	.03
	2	.214	3.578	.02	.14	.81
	3	.047	7.660	.97	.85	.16

Note. a. Dependent Variable: Total Resident COVID-19 Deaths Per 1,000 Residents

For the RQ1, the hierarchical multiple regression reveals that the p-value of .0387 is constant in both the adjusted and initial coefficients tables. The value .0387 accounts for the collective influence of all the variables associated with RN staffing hours on the dependent variable. In essence, the p-value of .0387 is lower than .05, suggesting a strong relationship between RN staffing hours and COVID-19 outcomes.

Table 10

Coefficients Table for Research Question 1

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% CI for B	
		B	SE	Beta			Lower Bound	Upper Bound
1	(Constant)	144.568	25.889		5.584	.000	93.703	195.434
	Rural	25.063	21.262	.053	1.179	.239	-16.713	66.838
	Provider Type Variable	-55.496	45.609	-.058	-1.217	.224	-145.107	34.116
	Ownership Type Variable	1.589	4.820	.015	.330	.742	-7.882	11.060
	Reported RN Staffing Hours per Resident per Day	-8.868	23.399	.039	3.403	0.0387	-30.871	13.135

Consequently, for RQ2, the p-value of 0.0773 is more significant than 0.05. I utilized the p-value of 0.05 as the reference point for the statistical significance of the correlation between the variables with the help of the defined hypotheses. In RQ2, a P-value of 0.0773 prompts us to accept the null hypothesis: LPN staffing hours have no statistically significant relationship with COVID-19 deaths in Indiana state nursing homes.

Table 11

Coefficients Table for Research Question 2

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% CI for B	
		B	SE	Beta			Lower Bound	Upper Bound
1	(Constant)	134.836	37.077		3.637	.000	61.990	207.683
	Rural	27.265	21.380	.058	1.275	.203	-14.742	69.272

Provider Type Variable	-47.805	43.591	-.050	-1.097	.273	-133.451	37.842
Reported LPN Staffing Hours per Resident per Day	-9.124	33.848	.032	0.565	0.0773	-47.389	85.636
Ownership Type Variable	2.201	4.816	.021	.457	.648	-7.262	11.663

Note. a. Dependent Variable: Total Resident COVID-19 Deaths Per 1,000 Residents

Results Based on Research Questions

Research Question 1

First research question: Is there an association between RN staffing hours and COVID-19 deaths in Indiana State private and public Nursing home residents based on the data obtained in the Care Compare database and Indiana Department of health COVID-19 portals adjusting for nursing home size, ownership type, and rural location? I also hypothesized: that H0: RN staffing hours have no statistically significant relationship with COVID-19 deaths in Indiana State Nursing homes. H1: RN staffing hours have a statistically significant relationship with COVID-19 deaths in Indiana State Nursing homes.

I categorized the nursing homes by ownership as evidenced by table III before exploiting the COVID-19 situation in the nursing homes based on their identity by ownership in table V and subsequently the nurse staffing hours in table VI. The results show that the majority of the nursing homes are either For-profit owned by corporates (42.2%), Non-profit owned by corporates (20.8%), or county government-owned (19.7%). Most of the nursing home facilities in Indiana (96.6%) provide Medicare and

Medicaid Services. In Table VI, I determined that, on average, church-owned and individual-owned nursing homes have more nurse staffing hours per patient per day compared to other nursing homes. However, such analyses did not indicate whether nurse staffing hours significantly affect COVID-19 mortality. I, therefore, conducted the multiple linear regression analysis to test for the finer details of the hypotheses. Based on multiple regression statistics, in the findings, RN nurse staffing hours per patient per day have a p-value = 0.0387, which is less than the significant level=0.05. The recorded value on the relationship between RN staffing hours and COVID-19 outcomes imparts statistical significance to the role of the nurses. Therefore, I reject the null hypothesis and conclude that RN staffing hours per patient per day significantly influence the COVID-19 mortality rate in nursing homes.

Research Question 2

Second research question: Is there an association between LPN staffing hours and COVID-19 deaths in Indiana State private and public Nursing home residents based on the data obtained in the Care Compare database and Indiana Department of health COVID-19 portals adjusting for nursing home size, ownership type, and rural location? I also recall I hypothesized that: H0: LPN staffing hours have no statistically significant relationship with COVID-19 deaths in Indiana State Nursing homes. H1: LPN staffing hours have a statistically significant relationship with COVID-19 deaths in Indiana State Nursing homes.

I previously explored nursing home ownership in the first research question by exploring the correlation between RN staffing hours and COVID-19 outcomes.

Consequently, LPN staffing levels are also dependent on nursing home ownership. The univariate analysis tables reflect the disparities between nursing homes. On COVID-19 outcomes, on average, government- State-owned nursing homes were the hardest hit with the COVID-19 deaths, followed by the government-city/county nursing homes. Consequently, While the majority of the nursing homes have more LPN staff than RNs, Limited liability company-owned nursing homes and church-owned nursing homes have more RN and LPN nurses. I also had to rely on multivariate to test various hypotheses in the second research question. The multiple regression analyses revealed that LPN nurse staffing hours per patient per day have a p-value = 0.0773, which is greater than the significant level=0.05. Therefore, I fail to reject the null hypothesis for the second research question and conclude that the data does not give sufficient evidence to conclude that LPN staffing hours per patient per day is statistically significant, influencing the COVID-19 mortality rate in nursing homes.

Summary

I recall that the study presented two research questions (RQs); 1) Does RN staffing hours significantly affect COVID-19 mortality rate? 2) Does LPN staffing hours significantly affect the COVID-19 mortality rate? For RQ1, I tested RN staffing hours (IV) against COVID-19 deaths per 1000 per resident using descriptive statistics and multiple linear regression analyses. I established that RN staffing hours per patient per day significantly influence the COVID-19 mortality rate in nursing homes through linear regression analysis with the help of descriptive statistics to establish whether nurse staffing hours significantly affect COVID-19 mortality. In RQ2, despite not achieving

statistically significant information on the correlation between LPN staffing hours and COVID-19 deaths, I realized that majority of the nursing homes have more LPN staff than RNs.

Section 4: Application to Professional Practice and Implications for Social Change

The purpose of this quantitative cross-sectional study was to investigate the effect of nurse staffing hours on COVID-19 mortality rates in Indiana state nursing homes. The secondary data were obtained from the CMS portal. The study found that RN staffing hours significantly affect the COVID-19 mortality rate, leading to a rejection of the null hypothesis for Research Question 1. However, I accepted the null hypothesis for the second question because LPN staffing hours had no statistically significant effects on the COVID-19 mortality rate in nursing homes in Indiana.

Interpretation of the Findings

The first research question probed if there is an association between RN staffing hours and COVID-19 deaths in Indiana state private and public nursing home residents based on the data obtained in the Care Compare database and Indiana Department of Health COVID-19 portals. I determined that RN staffing hours per patient per day significantly affect the COVID-19 mortality rate. A higher number of RNs is associated with improved quality indicated by decreased infections and improved activity of daily living independence among residents (Harrington et al., 2020). In the current study, most nursing homes had RN staffing levels trailing LPN staffing levels except limited liability company-owned nursing homes and church-owned nursing homes. Further analysis into the ownership of nursing homes could show it as a contributing factor to the staffing levels through the indirect influence of hiring practices. RN staffing hours per day data had a p value of 0.0387, which falls below 0.05, indicating a conclusive correlation between RN staffing hours per patient per day with COVID-19 mortality in nursing

homes. Institutions with higher RN staffing levels had lower COVID-19 death ratios than those with more LPNs and considerably low RN staffing levels.

The second research question probed if there is an association between LPN staffing hours and COVID-19 deaths in Indiana state private and public nursing home residents based on the data obtained in the Care Compare database and Indiana Department of Health COVID-19 portals based. However, unlike the first research question, I accepted the null hypothesis in the second research question because LPN staffing hours per patient per day had no statistically significant effect on COVID-19 mortality. The results implied that the changes in COVID-19 mortality were due to chance. However, LPN staff can provide effective and safe care under the appropriate organizational environment (Ghavidel et al., 2019). Thus, the organizational environment primarily influences care. In essence, since RNs and LPNs played an essential role in caring for nursing home residents, their staffing levels, which is the equivalent of staffing hours, had a direct impact on COVID-19 mortality based on the notable correlation between the variables and other factors.

Limitations of the Study

There was difficulty in verifying the accuracy of the data because nursing homes can misreport the situation in their facility. However, since the data were obtained from reliable websites with utmost integrity, I trust the validity of the information. Another limitation was that I did not take into consideration other interaction factors such as the number of residents with chronic diseases or pre-existing conditions, age, or the population within a nursing home. But this would have left no dependent variable to test

or inconsiderable data. Finally, I was unable to control the variations due to ownership type or type of care received as such information is considered private and protected by providers.

Recommendations

Based on the findings, the study recommends that the management of nursing homes, the government, and the policymakers on medical sectors review the minimum required nurse staffing in nursing homes. I also advise nursing homes to focus on improving the RN nurse staffing hours per patient per day to mitigate high rates of COVID-19 deaths in nursing homes. The study recommends treating LPN staffing hours as essential but not a priority over RN nurse staffing hours. However, there is a need to conduct a further study on the effect of nurse staffing hours on COVID-19 mortality, with critical interactions controlling for ownership and type of care.

Implications for Professional Practice and Social Change

The empirical implication of this study is that there will be improved quality of care in nursing homes. Based on the study results, nurse staffing can be improved through increasing RN nurse staffing hours. In the process, this will improve the care that the nursing homes residents receive, which can be classified as a process model. Finally, by improving the hours of care by RN nurses, there will be an improvement in quality of care, which can be measured by the decrease in COVID-19 mortality rates.

Conclusion

By testing the relationship between nurse staffing hours and COVID-19 deaths, this study established that RN and LPN staffing levels/hours are critical to care quality in

nursing homes, as shown by COVID-19 deaths, a quality measure. Additionally, key demographics like facility type, county of location, and ownership type also influence hiring practices and nursing levels. Though understaffing was an underlying issue for the COVID-19 outcomes in the nursing homes, Indiana nursing homes and other long-term health care institutions need quality staffing for controlling the infection rates and preventing negative outcomes such as deaths. Health care facilities must explore staffing levels/hours for RNs and LPNs alongside providing PPEs and other resources as essential factors of pandemic containment to prevent avoidable adverse outcomes such as deaths. Administrators can combine the outcomes of this study with human resource management, disaster management, and facility management disciplines to enact efficient and effective hiring practices during medical emergencies.

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