2021

The Impact of Telehealth Services Offered by Home Care Agencies on Patient Safety

Moyna Temple
Walden University

Walden University

College of Health Professions

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Moyna Temple

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Dr. Diana Naser, Committee Chairperson, Health Sciences Faculty
Dr. Martina Steed, Committee Member, Health Sciences Faculty
Dr. Mary Garbowski, University Reviewer, Health Sciences Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
2021

Abstract

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Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Healthcare Administration

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November 2021

Abstract

There is little available research about how home care agencies attempt to address patient safety during the nurse virtual healthcare visit. The purpose of this quantitative correlational study was to determine, during the delivery of telehealth care by a home care agency, to what extent the level of education of the registered nurse, the level of education of the director of the home care agency, and the clinical decision support system (CDSS) impact patient safety. The framework for the study was the complex sociotechnological systems model. Data from the 2007 National Home and Hospice Care Survey were analyzed using logistic regression analysis. The results of the analysis revealed that during the delivery of telehealth care by home care agencies, the level of education of the registered nurse and the level of education of the homecare agency director have statistically significant relationships to patient safety (routine video monitoring; $p = .02$). Additionally, the findings of the study showed that during the delivery of telehealth care by home care agencies, the CDSS has a statistically significant relationship to patient safety (staff use of CDSS guidelines; $p = .001$). The findings of this study could contribute to professional practice and social change by highlighting the levels of education at the home care level and the benefit of hiring trained professionals to understand patient safety tools such as CDSS guidelines and routine video monitoring.

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Dedication

The dedication of this study is to the direct care workers who provide home health care, especially during the recent COVID-19 pandemic.

Acknowledgments

Thank you to all family, friends, faculty, and co-workers who supported me throughout my academic career.

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Section 1: Foundation of the Study and Literature Review

Introduction

Telehealth services have faced healthcare-related challenges to interoperability of electronic healthcare records and healthcare institutions' capacity to provide care remotely (Dinesen et al., 2016). International research teams comprised of clinicians, analysts, and the like are banding together so that institutions in the United States (U.S.), Denmark, and Europe can develop solutions. Research and innovation must guide the solutions that address telehealth challenges (Dinesen et al., 2016; Fathi et al., 2017). This study narrows the scope of telehealth care challenges to some of the challenges the home care agency faces. My study could impact social change by sharing insight into how the home care nurse’s virtual healthcare delivery impacts patient safety.

In Section 1, I will discuss the foundation of the study and the literature review. In doing so, I will identify the problem statement, the study's purpose, the two research questions, and the hypotheses. Then, I will discuss the complex sociotechnological systems (CSTS) model, which builds the foundation for this study. Next, I will discuss the study's nature, the literature search strategy, and the literature review. The literature review includes critical concepts such as an overview of home care agencies, an overview of telehealth, leadership and nursing at home care agencies, the level of education of nurses, the level of education of the agency director, clinical decision support system (CDSS), and patient safety. I will also discuss definitions of some of the key terms used in the study, the assumptions, and scope and delimitations. Lastly, I will discuss the study's significance, summarize the section's hallmarks, and highlight the conclusion of Section 1.

Problem Statement

Nurse leaders have expressed challenges related to patient safety and regulatory compliance with telehealth nurses practicing in geographic locations other than where they are licensed to practice and reach the remote patient (Fathi et al., 2017). Policymakers must address some telehealth challenges with public policies that transcend the U.S. state and international borders (Dinesen et al., 2016). Nurses practicing virtual healthcare in the United States also encounter challenges with equipment and regulations that may impact patient safety and inpatient admissions. Some challenges in virtual healthcare may also relate to the patient's inability to navigate healthcare technology or technology distrust.

Some researchers have noted a bias in telehealth care since the patients who consent to participate in telehealth studies are usually familiar with technology (Dinesen et al., 2016). Some of the patients most affected by negative safety experiences may miss inclusion in telehealth studies because they are less engaged or may not consent to the study. However, these same patients who lack expertise in healthcare technology or distrust technology may be the same patients who the nurse encounters during the delivery of home health services or remote monitoring (Dinesen et al., 2016; Fathi et al., 2017). Furthermore, the home care nurse may be the main point of contact for ensuring the accurate transmission of patient data to physicians and other providers. These data points are then processed to inform actionable items in clinical decision-making to address patient care needs (Dinesen et al., 2016). This study addresses the specific gap and research problem of factors that affect how home care agencies address patient safety during the nurse's virtual healthcare delivery. Although researchers have investigated this issue, there is little or no literature on how home care agencies attempt to address patient safety during the nurse's virtual healthcare (See Guise et al., 2014).

Purpose of the Study

The purpose of this quantitative study was to determine, during the delivery of telehealth care by a home care agency, to what extent the level of education of the registered nurse, the level of education of the director of the home care agency, and the CDSS impact patient safety.

Research Questions and Hypotheses

RQ1: During the delivery of telehealth care by home care agencies, to what extent do the level of education of the registered nurse, and the level of education of the director of the homecare agency impact patient safety (routine video monitoring)?

$H_0$1 During the delivery of telehealth care by home care agencies, the level of education of the registered nurse, and the level of education of the director of the homecare agency have no statistically significant relationship to patient safety (routine video monitoring)

$H_1$1 During the delivery of telehealth care by home care agencies, the level of education of the registered nurse, and the level of education of the director of the homecare agency have statistically significant relationships to patient safety (routine video monitoring)

RQ2: During the delivery of telehealth care by home care agencies, to what extent does the CDSS impact patient safety (staff use of CDSS guidelines)?

$H_0$2 During the delivery of telehealth care by home care agencies, the CDSS has no statistically significant relationship to patient safety (staff use of CDSS guidelines)

$H_1$2 During the delivery of telehealth care by home care agencies, the CDSS has a statistically significant relationship to patient safety (staff use of CDSS guidelines)

Theoretical Foundation of the Study

Monteagudo et al. (2014) are the theorists who introduced the CSTS model, the framework and foundation for my study. Telehealth and patient safety are subsets of an extensive multi-dimensional system that includes influences outside the health care system. The CSTS model is comprised of five layers and depicts the flow of a multi-dimensional system (Monteagudo et al., 2014). The first layer is the component layer, the base layer, and includes people, the location of care delivery, data collection, processes for care delivery, and the organization. The second layer, the entities subsystem, includes patients, the professionals involved in care delivery, health information, external factors, interventions, and technology. The third layer is the telehealth system, which cannot operate independently of the other four layers. Layer four is the healthcare organization section and includes the regional and national aspects of care delivery. Lastly, the fifth layer, which makes up the top tier, is the healthcare ecosystem or society. One issue is that patient safety may not receive full attention during the delivery of telehealth services.

The administrator needs to be equipped with the data to substantiate systems such as the CDSS (Agency for Healthcare Research and Quality [AHRQ], 2020b). The findings of my study inform the healthcare administrator and focus on the telehealth and entities subsystem of the CSTS model. Furthermore, the second and third layers of the framework reflect patient safety in telehealth by addressing regulations and compliance, professional practice, and factors that affect the patient entity during care delivery (See Monteagudo et al., 2014).

The CSTS model is an appropriate framework to address patient safety in telehealth. The logical connections between the framework presented and my study's nature include that patient safety in telehealth requires a multidisciplinary approach (See Monteagudo et al., 2014). Also, the CSTS model's concept is that of an open system. The open system theory is the conceptual framework that aligns with my study on patient safety in telehealth since several factors interplay in telehealth care delivery at any one time. Furthermore, the interplay of the factors that affect telehealth care may result from internal and external sources. Katz and Kahn (1966) theorized that organizations are open to the environment but must ensure stability between the interconnected sectors. Criteria for an open system include importing and processing energy to create an output, cycles of events, negative entropy, feedback, dynamic homeostasis, differentiation, integration, coordination, and equifinality.

Additionally, according to Adams et al. (2017), at least one of the subsystems of an open system interacting with the external environment creates an opportunity for innovation. Furthermore, the more innovative the system, the higher the opportunity for evolution. Nadim and Singh (2019) posited that effective management entails managing the subsystems' interactions for the overall system's good. Similarly, the telehealth administrator addressing patient safety will need to manage the interactions between the patients, the nursing staff, the CDSS, and the unforeseen circumstances.

Nature of the Study

The study will include analyzing secondary data collected by the Centers for Disease Control and Prevention (CDC), National Center for Health Statistics' 2007 National Home and Hospice Care Survey (NHHCS; CDC, 2015). The CDC updated the survey in 2010. For this study, the program director permitted me to use the 2010 version of the 2007 NHHCS secondary dataset. The chosen design for this study is quantitative correlational because the data is numerical, and the design will allow for the testing of the hypotheses and relationships. The sample size is large, and analysis of the variables allows for a controlled study that is credible and repeatable (see Trochim, 2020; Walden University, n.d.a.). Independent variables include the level of education of the registered nurse, the level of education of the director of the home care agency, and the CDSS. The dependent variable is patient safety. One limitation of the study is that the data might not yield transferrable results in other telehealth areas. A challenge in this study is that there are limited comprehensive databases to research patient safety in telehealth.

Literature Search Strategy

Databases searched for this study included AARP Public Policy Institute; Academic Search Complete; CDC.gov; CINAHL Plus; Complementary Index; Directory of Open Access Journals; Gale Academic OneFile Select; Google Scholar; HRSA.gov;

Journals@OVID; Medicare.gov; Medline; PubMed; Research Starters; Science Citation Index; Science Direct; Supplemental Index; WHO.int; and Wiley Library.

The keywords searched included *decision making and methods, direct care worker and home care, digital health and patient safety, eHealth, homecare and agency, home care agency and leadership, rural healthcare and homecare, nurse and homecare, nurses and telehealth, telehealth, telehealth and home care, telehealth and Kim (Author), telehealth and Kim (Author) and nurse, telehealth and patient safety, telehealth or telemedicine and education level and nurse,* and *telemedicin*e.

The literature review scope included a look back at peer-reviewed journal articles and websites of expert organizations in telehealth, home care agencies, and patient safety published from 2014 to the present. The look back at relevant theories included peer-reviewed journal articles and a book published in 1966. There is little current research on telehealth safety in home care. This research study sheds some light on nurses and patient safety in telehealth, using a secondary data set from 2007. However, the literature related to telehealth, homecare, CDSS, and safety is current or published within the past 7 years.

Literature Review Related to Key Variables/Concepts

Overview of Home Care Agencies

According to the CDC (2016), in 2016, there were 12,200 home health care agencies (HHA) in the United States. Additionally, 4.5 million patients received home care services in 2015 (See CDC, 2016). Furthermore, based on the data collected for the U.S. Department of Health and Human Services, Health Resources and Services Administration (See USDOHHS-HRSA, 2020), Centers for Medicare and Medicaid

Services (CMS) Health Care Facilities; and the Hospital Compare website, around the year 2020, there were approximately 11,356 HHA in the United States. Of those, 11,170 were registered Medicare HHA (See CMS, 2020b).

An HHA certified as a Medicare or Medicaid provider under Title XVII of the Social Security Act provides skilled nursing and therapeutic services rendered by a group of professionals (See CMS, 2020b). Additionally, a physician or a registered professional nurse supervises the services provided (does not include agencies that provide only mental health care). One of the requirements to receive Medicare-covered home health services was that a physician deemed the patient homebound (See CMS, 2020c). As of October 31, 2018, home health's final rule has improved access to services offered by remote patient monitoring (See CMS, 2018). CMS upgrading remote patient monitoring fosters improvements in care and treatment plans.

The National Association for Home Care and Hospice (NAHC, 2020) represents the home care and hospice agencies in the United States. NAHC also advocates for the agencies' caregivers and keeps its members apprised of industry goals and benchmarks to maintain industry standards. According to the NAHC, home care includes a wide range of services often prescribed by a physician to individuals who require care at home for illnesses and disabilities under healthcare professionals' care. According to Browning and Clark (2015), magnet-designated hospital-based home care agencies (HHHA) promote a culture with more satisfied nurses and patients with higher outcomes. Additionally, magnet-designated agencies benefit from transformational leadership and nurses with high standards and formal education and certification (See Browning & Clark, 2015).

The NAHC partners with Fazzi Associates periodically to conduct studies on the HHA industry (NAHC, 2020). In a recent study, Fazzi Associates (2017) surveyed 751 home care and hospice leaders, and of the 751 respondents, 23% used telehealth services in homecare. Additionally, the agencies that used telehealth noted an increase in care quality. The respondents who did not use telehealth in homecare cited the systems as too costly, and some were concerned about not getting reimbursed for services. The Fazzi Associates study included senior leadership such that 81% of the 751 respondents were executives or administrators, and other respondents included chiefs and directors of finance, nursing, and operations. Additionally, of the 751 respondents, 73% used full-time registered nurses, and 24% used part-time and per diem registered nurses. There was no mention of nurses' level of education in home care or the agency directors' level of education (Fazzi Associates, 2017).

Landers et al. (2016) posited that connection to a continuum is one of the characteristics of innovative home health agencies. Furthermore, coordination of care is one of the hallmarks of the connectedness promoted in Medicare home health agencies (Landers et al., 2016). Another critical characteristic of the innovative agency is its technology capabilities to provide person-centered care with remote monitoring and remote access to care providers. However, a challenge with incorporating technology such as remote monitoring into home-based care is that Medicare does not necessarily reimburse for the services. In this case, the connection with a larger organization, such as HHHA, provides a safety net.

Overview of Telehealth

CMS (2016) published the Medicare Payment Advisory Committee report on telehealth. One point made in the report was that telehealth positively impacted reduced hospital admissions depending on the place of service. The federal financial support for telehealth care lacked the promotion of telehealth efficiency (See Pereira, 2017). Furthermore, the collaborators involved in enhancing telehealth care efficiency must include players like a federally mandated telehealth commission, the manufacturers of the equipment, software manufacturers, the telecommunication companies, and telehealth technology educators (See Hah & Goldin, 2019; Pereira, 2017).

Neonatal nurses, physicians, and parents collaborated to develop an application (app) for use in the neonate's care during homecare (Garne Holm et al., 2017). The study results about the app indicated that involving patients in the telehealth process from the start ensured that the technology met the patient's needs. mHealth is another form of telehealth related to mobile technology, such as a mobile phone (See Hamine et al., 2015). Short message service (SMS) was particularly relevant when promoting adherence to care protocols for chronic disease management. Additionally, mhealth promotes patient access to care and access to care providers.

Quinn et al. (2018) discussed telehealth in home care for seniors, including limitations. The researchers discussed barriers to telehealth such as regulations, Medicare and Medicaid reimbursement, state participation in Medicaid, and limitations on the type of telehealth service covered. Additionally, Medicare limited care provision based on the patient's geographic location and did not fully cover home services. These limitations potentially posed challenges for the home care nurse. Quinn et al. recommended employee training on a national level to overcome logistic challenges in rendering telehealth care.

In a recent study, Morony et al. (2018) addressed nurses in telehealth and their role in patient safety. The healthcare administrator can include training in the Teach-Back (T-B) method in the telehealth nurses' orientation process (Morony et al., 2018). The telehealth administrator will also be prudent to ensure that telehealth care models include attention to health literacy. Lastly, the leaders who support T-B to address patient safety will also need to address staffing. Innovation is a focus of health information technology. However, the industry must not overlook the need for empirical evidence and see that technology such as infusion pumps does not result in independent medication decisions without clinician input (See Sujan et al., 2019).

The impact of COVID-19 resulted in CMS adjusting the population of care and the scope of services included in telehealth and traditional home care. As of March 6, 2020, services received at home, including telehealth care from providers rendering care from their medical office, were included in telehealth home care (See CMS, 2020d). As a result of Waiver 1135, as of March 6, 2020, telehealth care included clinical psychologists and licensed social workers. In the past, Medicare restricted patients receiving telehealth to those living in rural areas who received services outside of the home in a medical facility.

Leadership and Nursing at Home Care Agencies

According to Cummings et al. (2018), relational leadership fosters improved nursing outcomes, ultimately benefiting patients' well-being. Yahaya (2020) posited that home health care leaders, including middle managers, may benefit from promotion and internal mobility within their organization more than formal leadership preparation. Furthermore, senior leadership in homecare who foster an inclusive environment will benefit from middle managers who are more supportive and satisfied (Yahaya, 2020). The study by Yahaya employed a small sample. However, the findings enhance the reader's understanding of homecare leadership from the management staff's perspective.

The homecare directors who participated in one study posited that telehealth is a viable care delivery mode for chronic care and depression (Kim et al., 2019). However, barriers to the ongoing telehealth usage in homecare include funding and reimbursement for the services. Another study's researchers identified a need for tele-homecare in home health nursing, particularly chronic disease management (Radhakrishnan et al., 2016). Nurses need to be at the table when making decisions about telehealth, outcomes, and innovation (Yesenofski et al., 2015). Additionally, home care agencies will do well with having nurses in leadership capacities as they are heavily engaged in providing care and affecting outcomes.

The 2018 National Sample Survey of Registered Nurses (NSSRN) referenced 3,272,872 registered nurses in nursing positions (USDOHHS-HRSA, 2019). Of those, it was not clear how many were home care employed. However, 68.2% of the 50,273 registered nurse respondents were hospital-employed in inpatient areas, 15.6% in ambulatory care, and 16.2% in other care settings. Of the total number of nurses surveyed, 32.9% of nurses utilized telehealth in the workplace, and 49.2% of those were registered nurses who utilized telehealth in direct patient care (USDOHHS-HRSA, 2019).

The consensus is that much of the nurse interaction with patients in their homes is by daily transmissions of data from the patient's tele-homecare device and communication with physicians (Radhakrishnan et al., 2016). Overall, telehealth's sustainability in homecare requires a significant nurse-patient relationship, agency culture, and technology supporting quality and improved outcomes.

One of the registered nurse's roles in home care is supervising the home health aides, home care aides, and personal care workers who make up the direct care worker workforce (Stear, 2017; Stone, 2016). Some direct care workforce members are migrant workers, some of whom may be nurses with unverifiable qualifications (Stone, 2016). Several challenges arise from using the migrant direct care work pool. For one, there may be language and communication barriers between the worker and the client. Additionally, education and training may lack instruction about caring for the elderly patient population.

Level of Education of Nurse and Level of Education of Director

According to the USDOHHS-HRSA (2019) 2018 NSSRN study, 63.9% of the 50,273 registered nurse respondents had a college education (USDOHHS-HRSA, 2019). Of those, 29.6% achieved associate degrees, 44.6% held bachelor's degrees, and 19.3% held graduate degrees. However, there was no mention of nurses' education level in home care in the HRSA study. The gap in industry research around the home care nurse's level of education and the home care agency director’s level of education offered an opportunity for this study to analyze the level of education of both roles as they pertain to patient safety (See Fazzi Associates, 2017; USDOHHS-HRSA, 2019).

Elliott and DeAngelis (2017) provided a nurse’s perspective on the process and challenges of transitioning from hospital-based care to home care. The home care agency’s effectiveness in keeping patients safe during the transition relied on the hospital discharge instructions (Elliott & DeAngelis, 2017). However, often overlooked, keeping patients safe relies on the home care nurse’s ability to follow the instructions or be in tune with the patient, regulations, and nursing practice. Additionally, nurses who practiced without a bachelor’s degree were not well-versed in community-based nursing, such as homecare. According to Elliott and DeAngelis, 60% of nurses were hospital prepared, highlighting the home care nurse’s knowledge gap. From a patient safety perspective and assessing and working towards filling the home care nurse’s gap in knowledge, the HHA has the responsibility to assess patient care needs in the home, including the patient’s need for and ability to participate in telehealth services.

Approximately three million home health aides and personal care assistants care for clients living in the home (Spetz et al., 2019). The direct care workers in this workforce tend to have limited training to provide homecare. According to Spetz et al. (2019), one in five home care workers were born outside of the United States. The uncertainty surrounding immigration policies is a barrier to homecare agency recruitment and training efforts. In some cases, the level of training of the home health aide drives the level of care and patient safety (Stear, 2017). However, there is a gap in research related to the correlation between direct care worker training and quality of care outcomes (See Spetz et al., 2019). The home health aide's level of training and scope of practice adds value to nursing study in home care agencies.

In some U.S. states, home health aide training requirements are minimal (Stear, 2017). In other U.S. states, the nurse trains the home health aide and delegates tasks (Spetz et al., 2019). Delegation of tasks such as medication administration, insulin pump assistance, and other nursing tasks is made seamless with telehealth as nurses connect with aides remotely. Ultimately, if for no other reason but to facilitate effective patient care, it behooves the industry's leadership to implement protocols to address direct care worker training. Breen et al. (2016) supported the argument that staff and patient education and reeducation on the decision support system are necessary to enhance telehealth patient safety. Shulver et al. (2016) supported the argument that the nurse's education level or experience may affect whether algorithms and protocols are implemented or adhered to for promoting patient safety. Hah and Goldin (2019) posited that telehealth technology training in nurse education improved staff confidence in care delivery. Additionally, training the health care workforce should include comprehensive development and guidance for passing competencies and continuing education (World Health Organization [WHO], 2015).

Clinical Decision Support System

According to the AHRQ (2020a), CDSS includes guidelines, contraindications, and alerts about medications and allergies. They can add value to a telehealth system to provide high-quality health care (AHRQ, 2020a). Furthermore, CDSS has existed for about 40 years and is often under-utilized to make informed decisions about diagnosing and treating patients (AHRQ, 2019; AHRQ 2020b). CDSS promotes team-based care, patient engagement, patient safety, and improved outcomes (AHRQ, 2019). The HITECH Act of 2009 was a federal rule that promoted health information technology based on incentives that necessitated the inclusion of CDSS. According to the AHRQ (2020a), patient safety protocols must include reviewing the protocols within the CDSS. Adverse events, such as those resulting from inferior medication management, still lead to thousands of deaths annually. Patient safety is an ongoing challenge that healthcare providers need to address by implementing real-world improvements that address the system's specific needs to which it is applied.

The results of several studies showed support for tele-homecare but weighed in on the need to address challenges for telehealth success. A study by Radhakrishnan et al. (2016) listed the quality of technology as one of the six themes of potential barriers to tele-homecare. The study results by Kaminsky et al. (2017) were transferable for analyzing telenursing goals in the United States. Some managers mentioned the importance of clinical decision software but identified a need for attention to health promotion in the software (Kaminsky et al., 2017). Parimbelli et al. (2018) posited that CDSS could pose significant risks if the system and the patient's needs are not aligned. The patient also has to have an appropriate literacy level and language base for understanding the system's instructions (Parimbelli et al., 2018).

The CDSS is complex, not all are equally created, and they are efficient based on the purpose for which they are built (Shortliffe & Sepúlveda, 2018). Some CDSS excel in medication management or therapeutics, or diagnostics, or care planning. CDSS still lacks in prompting the user about regulatory standards that support a decision. In the study by Sockolow et al. (2016), some homecare nurses identified a need for improvements in the readmissions from home to hospitals. The study's findings suggested that the electronic medical record may reintroduce redundancies in nurse communication and workflow addressed at the hospital level (Sockolow et al., 2016). Ultimately, the electronic medical record introduced barriers to the nurse's decision-making capabilities related to the admission process. Additionally, CDSS often provided conflicting decisions that either supported diagnosis or therapeutics, leaving the end-user to choose the best decision (Shortliffe & Sepúlveda, 2018). According to Shortliffe and Sepúlveda (2018), CDSS lacked evidence-based protocol in supporting clinical decisions.

Zhang and Koch (2015) posited that remote monitoring might rely on a patient's use of applications (apps), presenting several challenges to patient safety in telehealth. According to the study by Zhang and Koch, the vetting of some apps did not occur, there were no trials or evidence-based data, and their reliability was unknown. Also, of concern was whether the patient was literate and understood the app (Zhang & Koch, 2015). The physician's lack of understanding of the apps may also impact patient safety. Some patients may not be competent to utilize the app, and self-reported data could not be considered credible. Also, Zhang and Koch studied that more medical devices and apps regulations are necessary to ensure patient safety. Based on the studies evaluated in the literature, the healthcare administrator can appreciate that their investment in a CDSS must include analyzing the system's ability to weed out patient and user-generated errors.

The CDSS processes must also align nursing care delivery and patient safety in the home care setting.

Patient Safety

The WHO (2019) defined patient safety as a discipline in health care that focuses on risk reduction and preventing errors and harm when providing patient care. Patient safety in telemedicine is understudied (See Agboola & Kvedar, 2016). The topic is worthy of further evaluation, as there is evidence that telemedicine improves patient outcomes. Additionally, according to Dinesen et al. (2016), patient safety in telehealth concerns care providers in the United States. Telehealth care also transcends international borders and requires sharing policies globally (Dinesen et al., 2016). The study by Clay-Williams et al. (2017) left room for exploring whether the provider's need to preserve their privacy during video monitoring would impact patient safety. Furthermore, De Raeve et al. (2017) posited that telehealth leaders must address nurse policy for patient care to be considered safe. According to De Raeve et al. (2017), care delivery’s safety must include attention to patient health literacy.

According to the AHRQ (2020a), patient safety protocols must include reviewing the protocols within the CDSS. One AHRQ report identifies 47 patient safety areas of focus for healthcare facilities (AHRQ, 2020a). Adverse events, such as those related to medication management, still result in the annual deaths of thousands of patients. Patient safety is an ongoing challenge that healthcare providers must address by implementing real-world improvements that address the health system’s specific needs. The chapters of interest in the AHRQ report related to homecare include diagnostic errors, clinical decision support errors, failure to rescue, infections, and harm due to anticoagulants. Other vital chapters address errors related to diabetic agents, opioids, and drug events in older adults, infusion pumps, delirium, care transitions, and cross-cutting practices. According to Hall et al. (as cited in AHRQ 2020a), patient safety in the context of clinical decision support is successful based on the accuracy of the data input.

Including the pharmacist in medication management within eHealth may help patients with safe medication management, particularly the elderly who seek care at home (See WHO, 2015). In Australia, the Home Medicine Review Service has assisted elderly patients at risk of medication mismanagement. WHO (2015) posited that training the healthcare workforce with instruction for utilizing technology is essential to the elder patient who seeks health care services. WHO also posited that reliance on the immigrant population to render care presents challenges to safety and ethics and results in pulling human resources from a pool of workers that may leave underserved countries without skilled healthcare workers.

The safety of mHealth or the use of mobile technology such as phones requires further evaluation as it relates to safety (Hamine et al., 2015). The cause for concern is related explicitly to mHealth's inability to address diversity in the community and the care needs of specific patient demographics. Furthermore, transmitting data via mobile technology sometimes requires additional equipment that may not be available to the patient. The equipment may not be available due to inaccessibility, lack of funds, or low health literacy. It is unclear how safety is affected by these missing devices.

Symptom checkers allow patients to self-check symptoms that they experience (Semigran et al., 2015). However, the results lead to either inappropriately staying home when sick or unnecessarily going to the emergency room. One health plan's telemonitoring system was a Bluetooth-enabled scale for heart failure patients, which reduced hospital admissions (Agboola et al., 2016). Healthcare needs to add to the body of knowledge by having medical organizations discuss and collaborate on safe protocols for homecare versus in-person care. Additionally, the U.S. Food and Drug Administration (FDA) lacks in managing the issues related to innovations in the digital health platform. The safety of software and apps utilized in digital health requires further analysis. In one 10-year study about telephone encounters, poor documentation resulted in 44% of patient injuries or deaths. According to Fathi et al. (2017), leaders in telehealth care delivery and nurse leaders expressly understand that regulations and compliance need to focus on patient safety. The next step is to advocate for reform that promotes safe nursing care delivery in telehealth (See Fathi et al., 2017).

Definitions

In this study, the definitions of the clinical decision support system, direct care worker, home health agency, level of education, patient safety, telehealth, and telemedicine are as follows:

Clinical Decision Support Systems: The CDSS include guidelines, contraindications, alerts about medications and allergies and is used to make informed decisions about diagnosing and treating patients (AHRQ, 2019, 2020a, 2020b). The 2007 NHHCS secondary dataset has the CDSS variable coded to indicate if the agency has

CDSS in place. Also, the NHHCS codes the variable CDSS guidelines to indicate whether the staff uses the guidelines (CDC, 2015).

Direct Care Worker: The direct care worker in home care can have multiple definitions. The direct care worker can be a registered nurse, licensed practical nurse, home health aide, or personal care assistant (Spetz et al., 2019; Stear 2017).

Home Health Agency: A home health agency certified as a Medicare or Medicaid provider under Title XVII of the Social Security Act provides skilled nursing and therapeutic services rendered by a group of professionals (CMS, 2020a, 2020b, 2020d). Also, a physician or a registered professional nurse supervises the services provided to the patient deemed homebound by a physician.

Level of Education: In the 2007 NHHCS, the variable level of education of the nurse is defined and coded as education ranging from a diploma to a master's degree or higher (CDC, 2015). The level of education of the agency director is defined and coded based on education ranging from a diploma to a doctorate.

Patient Safety: 2007 NHHCS included questions to address the use of technology during the delivery of patient care. In this study on telehealth and the home care agency, patient safety is defined based on the staff use of routine video monitoring and the staff use of the CDSS guidelines (CDC, 2015).

Telehealth: Telehealth promotes care access using technology such as the internet, virtual visits, remote monitoring, telephone, emails, and messaging (Kim et al., 2019; Quinn et al., 2018). mHealth is another form of telehealth related to the use of mobile technology, such as a mobile phone (Hamine et al., 2015; Parimbelli et al., 2018).

Telemedicine: Telemedicine uses electronic communication to exchange medical information from one provider to another (Parimbelli et al., 2018; Pereira, 2017). This exchange of information facilitates improvements in the patients' health status with medical expertise.

Assumptions

This study has assumptions that are not possible to demonstrate but that I believe to be true. These assumptions include that the home care agencies verified the nurse's education level and the director of the homecare agency's education level when collecting the staff characteristics data on the NHHCS (CDC, 2015). The other assumption is that the nurse used the CDSS during the delivery of onsite homecare services and virtual home care services when documenting patient data for the NHHCS. These two assumptions are essential since the study's primary goal is to understand the correlation between education and patient safety. Also, possibly the caregiver did not consult the CDSS during both onsite and virtual health care delivery. In that case, patient safety was not truly reflective of the relevance of CDSS at the virtual home care level of service.

Scope and Delimitations

Nurses who practice virtual healthcare in the United States encounter challenges with equipment and regulations that may impact patient safety and inpatient admissions (Dinesen et al., 2016). Although researchers have investigated patient safety and virtual health care, there is little or no literature on how home care agencies attempt to address patient safety during the nurse's virtual healthcare (Guise et al., 2014). This study addressed the specific research problem of factors that affect how home care agencies address patient safety during the nurse's virtual healthcare delivery. Specifically, I looked at the nurse's level of education and the home care agency director's education level to identify a correlation with patient safety at the agency. With the understanding that community-based nurses tend to hold fewer bachelor's degrees than hospital-based nurses, the education level study assessed the direct impact on patient safety (Elliott & DeAngelis, 2017). I also examined the usage of the CDSS and its correlation to patient safety. The CDSS usage analysis will add another layer for evaluating the likelihood of CDSS use based on education level. With internal validity in mind, simultaneously looking at the results of RQ1 and RQ2 may shed some light on the correlation of education, the use of CDSS, and patient safety in home care.

The choice of the CSTS model in this study above the complex adaptive systems (CAS) theory was because the CSTS represents both the open system of healthcare and the technological component of telehealth (See Monteagudo et al., 2014). The CAS, although an excellent representation of a complex system such as healthcare (See Ratnapalan & Lang, 2020), appeared to be too broad and all-encompassing for this study. The CSTS was ideal since the representation of the open healthcare system and the technology component depicts the flow of the homecare nurse's experience during telehealth care delivery. However, the 2007 NHHCS included data specific to the home care and hospice industry, so this study's results may not generalize to other healthcare services (CDC, 2015).

Significance, Summary, and Conclusions

This study was significant because it provides the healthcare administrator with tools to address patient safety in telehealth. The availability of patient education in various languages may address whether communication between patient and caregiver is safe, effective, and in a language that the patient can understand (Garne Holm et al., 2017; Hamine et al., 2015; Parimbelli et al., 2018). CDSS has added a high safety standard in telehealth care (AHRQ, 2020b; Shortliffe & Sepúlveda, 2018). When making hiring decisions, the administrator (director) may want to know if the nurse's education level will predict the frequency of using CDSS (Elliott & DeAngelis, 2017; Shulver et al., 2016). The healthcare executive who needs to make a hiring decision about the best fit for the agency will find it helpful to know the correlation between the director's education level and its telehealth abilities (Yahaya, 2020; Yesenofski et al., 2015).

The study impacts social change by addressing safety in the nurse’s telehealth care delivery in home care agencies (See Elliott & DeAngelis, 2017; Spetz et al., 2019). The nurse’s perception is that including telehealth technology when providing care can improve their performance (See Hah & Goldin, 2019). This study’s ultimate impact on social change encourages home care agencies to work with educators to provide telehealth technology-based education (See Hah & Goldin, 2019; Spetz et al., 2019). The trickle-down effect could be improved telehealth home care performance and safer patients (See Elliott & DeAngelis, 2017; Hah & Goldin, 2019).

Additionally, the study can provide healthcare agencies with knowledge about the RN and agency director’s ideal education level (See Elliott & DeAngelis, 2017;

Yesenofski et al., 2015). Lastly, the study sheds light on the need to invest in CDSS used in home care and telehealth to address patient safety (see Guise et al., 2014; Shulver et al., 2016). In Section 2, the description of the quantitative research includes variables that assess education and the use of the CDSS guidelines. Lastly, in Section 2, the details of the data collection process highlight how education and the use of the guidelines in the CDSS impact patient safety during home care.

Section 2: Research Design and Data Collection

For this study, I employed a quantitative correlational design using a simple regression analysis method to examine the relationship between two independent variables and one dependent variable for RQ1. The regression analysis method examined the relationship between one independent variable and one dependent variable for RQ2. The purpose of the correlational study was to determine, during the delivery of telehealth care by a home care agency, to what extent the level of education of the registered nurse, the level of education of the director of the home care agency, and the CDSS, impact patient safety. In Section 2, I will detail the research design and the rationale of the study. The study's methodology included evaluating the three independent variables from the secondary data included in the 2010 version of the 2007 NHHCS: (a) the level of education of the registered nurse, (b) the level of education of the director of the home care agency, and (c) the CDSS, and their relationships to the dependent variable, patient safety. I will also detail the threats to validity and the steps taken to address them. Additionally, the identification of the ethical procedures demonstrated respect for the privacy of the respondents. Lastly, I will summarize the research design and data collection process.

Research Design and Rationale

The study employed a quantitative correlational design. The rationale for the choice of study design was to understand if there was a correlation between the three independent variables and the dependent variable. RQ1 was “During the delivery of telehealth care by home care agencies, to what extent do the level of education of the registered nurse, and the level of education of the director of the homecare agency impact patient safety (routine video monitoring)?” The independent variables for RQ1 were the level of education of the registered nurse, and the level of education of the director of the homecare agency. The dependent variable was patient safety (routine video monitoring). RQ2 was “During the delivery of telehealth care by home care agencies, to what extent does the CDSS impact patient safety (staff use of CDSS guidelines)?” The independent variable for RQ2 was the CDSS, and the dependent variable was patient safety (staff use of CDSS guidelines).

Time and resource constraints consistent with correlational design included devoting time to review the large 2007 NHHCS dataset (CDC, 2015). However, studying a large dataset promoted generalizable results to homecare agencies (Curtis et al., 2016). The generalizable results may also transfer to other healthcare delivery modes. A correlational research study yields evidence to show relationships between the study variables (Seeram, 2019). First, I identified whether the study variables were scale or ordinal (See Curtis et al., 2016). Then I devoted time to ascertain the strength of the variables’ positive or negative and linear or non-linear relationships (See Curtis et al., 2016; Seeram, 2019). I applied Pearson correlation coefficients for the interval or ratio variables and Pearson’s *r* to denote the study’s correlational design. I also ran frequency tables and descriptive statistics to calculate the mean and standard deviation. Additionally, I took time to analyze the secondary and correlational data to determine the extent to which the variables related to each other to inform the hypotheses and evidence-based practice (See Seeram, 2019). I also needed time to identify valid and reliable measurements to inform the study (See Curtis et al., 2016).

It also took time to avoid making mistakes in analyzing the data and inferring a causal relationship rather than a linear correlational relationship (See Curtis et al., 2016). I was also careful about relating the variables' correlational results to the large population. I needed to take the time to study the correlated variables to see to what extent a change in one variable affects a change in another. According to Curtis et al. (2016), researchers used a correlational design to study the relationship between nurse leadership and patient outcomes in the past. This study about homecare agencies identified the extent to which nurse and agency director education and CDSS impact patient safety.

The quantitative correlational design was consistent with research designs needed to advance knowledge in healthcare administration. Correlational research informs the evidence-based practice important to healthcare leaders and practitioners (See Curtis et al., 2016; Seeram, 2019). The results of this study identified to what extent the administrator will want to consider the correlation of the nurse's level of education and the home health director's education with patient safety at the agency (See Elliott & DeAngelis, 2017; Yesenofski et al., 2015). In this study, I targeted home care leaders and nurses who make decisions or follow metrics related to patient safety. The correlation of the variables also informs hiring decisions and the selection of CDSS based on potential patient safety outcomes.

Methodology

Population

In 2016, there were 12,200 HHAs (See CDC, 2016). Also, according to the 2018 NSSRN, there were 3,272,872 registered nurses in nursing positions. Of the nurses surveyed, 49.2% of the registered nurses used telehealth in direct patient care (See USDOHHS-HRSA, 2019). The target population of the 2007 NHHCS was Medicare and Medicaid certified or state-licensed home health and hospice services providers who were currently or recently providing services (See CDC, 2015). The study results included data from 1,036 home care and hospice agencies that participated and the 9,416 patients who were current or discharged during the study. The study did not include agencies that provided only homemaker services, housekeeping services, assistance with daily living activities, or durable medical equipment.

The respondents of the 2007 NHHCS included agency directors and staff (See CDC, 2015). The data included information from in-person interviews, a review of administrative records, and medical records. The data relating to the agency collected from the administrative records included agency services provided and staffing characteristics. The patients' data included medical records such as services received, diagnoses, and medications taken.

Sampling Procedures

The sampling strategy used in the 2007 NHHCS included a stratified two-stage probability sample design (See CDC, 2015). The CDC’s National Center for Health Statistics (NCHS) conducted the first stage and selected the home health and hospice agencies. According to NHHCS, the primary sampling strata were agency type and their status in the metropolitan statistical area. The sample frame was 15,000 plus home health and hospice agencies providing services in the United States. The NHHCS further sorted the agencies within the strata by census region, ownership, certification status, state, county, ZIP code, and size (number of employees; CDC, 2015). The first stage of sample selection entailed the systematic and random sampling of 1,545 agencies.

The agency interviewers completed the second stage of the sample selection (See CDC, 2015). The agency director or designee provided a census list for the second stage, which informed the computer algorithm to randomly select the current home health and hospice patients and discharges. According to the NHHCS documentation, up to 10 current home health patients were randomly selected per home health agency, up to 10 hospice discharges were randomly selected per hospice agency, and a combination of up to 10 current home health patients and hospice discharges were randomly selected per mixed agency. Furthermore, current home health patients were those active with the agency as of midnight of the day before the interview. The hospice discharges occurred during the 3-month period that began 4 months before the interview and included sampled patients discharged due to death.

According to the documentation for the 2007 NHHCS, the inclusion criteria for the sampling frame included three sources (See CDC, 2015). The three sources were (a) the CMS Provider of Services file of home health agencies and hospices, (b) state licensing lists of home health agencies compiled by a private organization, and (c) the National Hospice and Palliative Care Organization file of hospices. The criteria for exclusion from the sampling frame were duplicate files from the three sources. After the removal of the duplicate files, 15,488 agencies made up the sampling frame.

Additional procedures for recruitment and participation associated with the secondary data set was included in the Scope of Survey section of the 2007 NHHCS documentation and is shown in Appendix A. See excerpt from Appendix A below:

> For the 2007 NHHCS, a sample of 1,545 agencies was selected. Only agencies providing home health or hospice care services to patients at the time of the survey or recently before the survey were eligible to participate in the NHHCS. Of the 1,545 agencies in the sample, 1,461 (95 percent) were considered in scope. The 84 out-of-scope agencies were ineligible for one or more of the following reasons: did not meet the definition used in the survey, had gone out of business, was a duplicate of another sampled agency, or had merged with other sampled agencies. Of the in-scope agencies, 1,036 agreed to participate, resulting in a first-stage agency unweighted response rate of 71 percent and weighted response rate of 59 percent. A total of 10,009 current home health patients and hospice discharges were sampled from the responding agencies: 5,026 current home health patients and 4,983 hospice discharges. Of these, 106 home health patients and 19 hospice discharges were considered out of scope. Furthermore, 237 current home health patients and 231 hospice discharges were excluded due to one of the following reasons: consent problems, record problems, refusals, ran out of time, and nonresponse. This resulted in 4,683 home health cases and 4,733 hospice cases, for a second stage unweighted response rate of 95 percent (9,416/9,884)

and weighted response rate of 96 percent. For the NHHCS patient health module, the overall unweighted response rate was 66 percent and the overall weighted response rate was 55 percent. Weighted and unweighted response rates are reported per Office of Management and Budget's (OMB) September 2006 Standards and Guidelines for Federal Statistics. Weighted rates measure the proportion of the total population that is represented by respondents while unweighted rates reflect only the proportion of the sample that responded. (CDC, 2015, p. 4).

Additional procedures for data collection associated with the secondary data set was included in the Data Collection Procedures section of the 2007 NHHCS documentation and is shown in Appendix A. See excerpt from Appendix A below:

The 2007 NHHCS was administered in sampled home health and hospice agencies, between August 2007 and February 2008, using a computer-assisted personal interviewing (CAPI) instrument that was loaded onto each interviewer's laptop. CAPI consisted of five modules: Agency Qualifications and Characteristics (AQ), Patient Sampling (PS), Patient Health (PH), Patient Charges and Payments (PA), and Aide Sampling (AS). A self-administered staffing questionnaire was also mailed to the agency directors who were asked to complete it before the in-person agency interview. (CDC, 2015, p. 6).

Data were collected according to the following procedures: (1) An advance package of NHHCS information, including a letter from the NCHS director, was mailed to the director of each sampled agency, informing him/her of the purpose, content, and authorizing legislation of the survey and that he/she would be contacted by telephone to schedule an appointment. The advance package included letters of support from the National Hospice and Palliative Care Organization and from the National Association for Home Care and Hospice. Also included in the package was a copy of an NCHS report–The Use of Computerized Medical Reports in Home Health and Hospice Agencies: United States, 2000–to illustrate how the survey data can be used to present important findings in the industry. (2) After the package was mailed, the interviewer telephoned the sampled agency to speak to the director, explain the survey in further detail, address any questions or concerns about NHHCS, and schedule an in-person interview with the director. (3) After the interviewer successfully scheduled an interview, a confirmation package was mailed to the director. This package included a confirmation letter with details about agency information the interviewer would need to complete the interview, in addition to the self-administered staffing questionnaire that the director was expected to complete by the day of the agency interview. (4) At the in-person agency interview, the interviewer collected the completed staffing questionnaire and administered the AQ module of CAPI. Provided the agency was eligible to participate in the survey, the interviewer sampled up to 10 current home health patients/hospice discharges using the PS module of CAPI. In mixed agencies, a combination of up to 10 current home health patients and hospice discharges were sampled, usually 5 of each; if 5 of either group was not available, the interviewer sampled more from the group that had more than 5 on the census list. The interviewer completed the sampling exercise by cleaning (e.g., identifying and removing duplicate names on a list of current home health patients) and numbering the census lists and entering the total number of current home health patients and/or hospice discharges into CAPI. Subsequently, CAPI randomly selected 10 numbers based on the total number of current patients/hospice discharges that were entered into the computer algorithm. The sampled patients/discharges were those corresponding to the randomly generated numbers in the census list. (5) The interviewer met with designated staffs that were familiar with the sampled patients/discharges and their care and collected information on the survey items in the PH and PA modules for each sampled patient/discharge. The respondents referred to patient medical records, administrative records, and medication administration records to answer the survey items. No patients or families/friends were interviewed directly. (6) The interviewer constructed a census list of currently employed home health aides, selecting up to six home health aides using the procedures described above for sampling patients/discharges, and requested contact information for each sampled home health aide. This information was used for NHHAS. (CDC, 2015, p. 6).

Additional procedures for estimation associated with the secondary data set was included in the Estimation Procedures and Reliability of Estimates sections of the 2007 NHHCS documentation and is shown in Appendix A. See excerpt from Appendix A below:

> Because the statistics from NHHCS and NHHAS are based on a sample, they will differ somewhat from the data that would have been obtained if a complete census had been taken using the same definitions, instructions, and procedures. However, the probability design of NHHCS and NHHAS permit the calculation of sampling errors. The standard error of a statistic is primarily a measure of sampling variability that occurs by chance because only a sample, rather than the entire population, is surveyed. The standard error also reflects part of the variation that arises in the measurement process but does not include any systematic bias that may be in the data or any other nonsampling error. The chances are about 95 in 100 that an estimate from the sample differs from the value that would be obtained from a complete census by less than twice the standard error. (CDC, 2015, p. 8).
>
> Standard errors can be calculated for agency, patient/discharge, and home health aide estimates using any statistical software package as long as clustering within agencies and other aspects of the complex sample design are taken into account. … . The design variables used to estimate characteristics in the patient/discharge file are the same design variables that should be used for the medication data, which were collected at the patient/discharge level. (CDC, 2015, p. 8).

The procedures for gaining access to the data set included contacting the NCHS to ascertain that the 2007 results updated in 2010 were the most current and that the data was available for public use. Permission to access the data included emailed communications with a health scientist at the Long-Term Care Statistics Branch, a healthcare statistics division at the NCHS. The health scientist emailed the link to access the data. However, the 2007 NHHCS is a public use data file and a permission letter to access the data file was not necessary.

Power Analysis

The power analysis tool used to calculate the sample size was PS: Power and Sample Size Calculation (See Dupont & Plummer, Jr., 2014). The power analysis with effect size = .2, alpha level = .05, and power level = .8 calculates a suggested sample size of 690 cases and 138 control cases randomly selected. The total number of cases studied in the 2007 NHHCS was 1,036 (See CDC, 2015). The Type I error probability associated with the null hypothesis was 0.05 (See Dupont & Plummer, Jr., 2014). Justifying the effect size or Cohen's *d*, alpha level or critical *p*-value, and the chosen power level was ideal, as the standard points in research idealize these values (See Mascha & Vetter, 2018).

Operationalization of Constructs

Operationalization

The independent variables for RQ1 were the level of education of the registered nurse and the level of education of the director of the homecare agency. The definition of education was high school educated, holds an associate degree, holds a bachelor's degree, or holds a master's degree. The dependent variable for question 1 was patient safety (measurable by staff use of routine video monitoring). In the context of this study, the WHO (2019) definition of patient safety was minimizing errors and keeping patients free from harm. The independent variable for RQ2 was the CDSS. The definition of a CDSS was the extent to which the agency provided a CDSS. The dependent variable for question 2 was also patient safety (measurable by staff use of CDSS guidelines). Again, the WHO (2019) definition of patient safety was minimizing errors and keeping patients free from harm.

Table 1

Variables

Variable	Variable Type	How Variable is Measured	Possible Responses
Level of education of the registered nurse	Scale	Staffing Questionnaire – PCTDIP SAQ16(a) - Percent RNs with highest degree of Diploma	0-69% 70=70-100% -1= INAPPLICABLE/NOT ASCERTAINED -7= RF -8= DK
	Scale	PCTASSOC SAQ16(b) - Percent RNs with highest degree of Associate Degree	0-100% -1= INAPPLICABLE/NOT ASCERTAINED -7= RF, -8 = DK
Level of education of the registered nurse cont'd	Scale	PCTBS SAQ16(c) - Percent RNs with highest degree of BS/BSN (4 year)	0-79% 80= 80-100% -1= INAPPLICABLE/NOT ASCERTAINED -7= RF, -8= DK
	Scale	PCTMS SAQ16(d) - Percent RNs with highest degree of MS/MSN or higher	0-24% 25=25-100% -1= INAPPLICABLE/NOT ASCERTAINED -7= RF -8= DK

Variable	Variable Type	How Variable is Measured	Possible Responses
Level of education of the director of the homecare agency	Nominal	Staffing Questionnaire – DIRDEGHI SAQ4 - Agency's Director/ Administrator highest degree of any kind	1=DIPLOMA DEGREE IN NURSING 2=ASSOCIATES DEGREE IN NURSING 3=ASSOCIATES DEGREE IN HEALTH CARE ADMINISTRATION 4=ASSOCIATES DEGREE (OTHER HEALTH RELATED) 5=ASSOCIATES DEGREE (NOT HEALTH RELATED) 6= BACHELORS DEGREE IN NURSING 7=BACHELORS DEGREE IN HEALTH CARE ADMINISTRATION 8=BACHELORS DEGREE (OTHER HEALTH RELATED) 9=BACHELORS DEGREE (NOT HEALTH RELATED) 10= MASTERS DEGREE IN NURSING 11= MASTERS DEGREE IN HEALTH CARE ADMINISTRATION 12=MASTERS DEGREE (OTHER HEALTH RELATED) 13=MASTERS DEGREE (NOT HEALTH RELATED) 14=DOCTORATE LEVEL DEGREE (E.G., MD, PHD, JD) 91= OTHER (SPECIFY) -1= INAPPLICABLE/NOT ASCERTAINED -7= RF -8= DK
The clinical decision support system	Nominal	Staffing Questionnaire – CDSS SAQ80(e) - Clinical Decision Support System (CDSS) contraindications, allergies guidelines, etc.	1= USED 2= AVAILABLE, NOT USED 3= NOT AVAILABLE -1= INAPPLICABLE/NOT ASCERTAINED -7= RF -8= DK
Patient safety	Nominal	Staffing Questionnaire – VIDEOPAT SAQ84(d) - Routine video monitoring of patient	1= YES 2= NO -1= INAPPLICABLE/NOT ASCERTAINED -7= RF -8= DK
	Nominal	GUIDEPDA SAQ90(d) - Clinical Decision Support System guidelines	1= YES, 2= NO -1= INAPPLICABLE/NOT ASCERTAINED -7= RF, -8= DK

Data Analysis Plan

For the data analysis, I employed IBM SPSS Statistics 27 (See Walden University, n.d.b). Data cleaning procedures included eliminating incomplete responses or answers that equated to zero or not applicable. I did not use missing or unknown records. The research questions and hypotheses were:

RQ1: During the delivery of telehealth care by home care agencies, to what extent do the level of education of the registered nurse, and the level of education of the director of the homecare agency impact patient safety (routine video monitoring)?

$H_0$1 During the delivery of telehealth care by home care agencies, the level of education of the registered nurse, and the level of education of the director of the homecare agency have no statistically significant relationship to patient safety (routine video monitoring)

$H_1$1 During the delivery of telehealth care by home care agencies, the level of education of the registered nurse, and the level of education of the director of the homecare agency have statistically significant relationships to patient safety (routine video monitoring)

RQ2: During the delivery of telehealth care by home care agencies, to what extent does the CDSS impact patient safety (staff use of CDSS guidelines)?

$H_0$2 During the delivery of telehealth care by home care agencies, the CDSS has no statistically significant relationship to patient safety (staff use of CDSS guidelines)

$H_1 2$ During the delivery of telehealth care by home care agencies, the CDSS has a statistically significant relationship to patient safety (staff use of CDSS guidelines)

As part of the analysis plan, statistical tests for the hypotheses included logistic regression, the chi-square test for independence, and the Fisher's exact test (See Curtis et al., 2016). The tests studied the relationship between the categorical independent variables and one categorical dependent variable. The logistic regression facilitated a parametric review of the data. The chi-square and Fisher's exact tests are non-parametric tests best suited for nominal or ordinal data that does not fit into the normal distribution convention (See Connelly, 2019; Curtis et al., 2016). I used Fisher's exact test to understand the null hypothesis's rejection; however, $p = .05$ was not a necessary standard (See Stang & Kowall, 2020). For the Fisher's test, the lower the *p*-value, the more substantial the evidence to reject the null hypothesis. The one-way chi-square tests different proportions in one variable, and the two-way test looks for differences in two variables (See Connelly, 2019). Procedures used to account for this study's multiple statistical tests were their approximation to $p < .05$ and an understanding of rejection of the null hypothesis (See Stang & Kowall, 2020). I identified the degrees of freedom, the critical *p*-value, and the *p*-value for the chi-square test statistic as determined by reviewing the chi-square distribution table (See Judge, 2017). I interpreted the results with probability values based on the mentioned assumptions, which may or may not have resulted in $p < .05$. Some researchers may look for $p = 0.01$ as statistically significant (See Connelly, 2019). Ultimately, if the critical *p*-value and the tabular *p*-value were similar, I may determine no significant variation. The chi-square test dictated the result and, when $p < .05$, I rejected the null hypothesis.

Threats to Validity

External Validity

Threats to external validity, for example, the specificity of variables, may not yield generalizable results. However, threats to external validity were limited since the study addressed real-world scenarios in the home care agency and other healthcare service areas may replicate the study (See Andrade, 2018; Huebschmann et al., 2019).

Internal Validity

Internal validity relates to opportunities for bias in the study (See Andrade, 2018). The 2007 NHHCS limited internal validity threats by instrument vetting, randomly selecting the participants, and deidentifying the participants (See CDC, 2015).

Construct Validity

A threat to construct validity was the possibility of Type I or Type II error. The Type I error occurs if I reject the null hypothesis when it is true (See Mascha & Vetter, 2018). If I committed a Type II error, that means I accepted the null, although the null was false. However, when $p < .05$, I appropriately rejected the null hypothesis. It was also essential to align the study with industry standards and use appropriate statistics to analyze the error (See Frongolli et al., 2019). The 2007 NHHCS employed the relative standard error (RSE) (See CDC, 2015). One method of ascertaining construct validity was to ensure that if an estimate was 60 sample cases or more with an RSE of less than 30 percent, the estimate was considered reliable or valid.

Ethical Procedures

The 2007 NHHCS results were a publicly available secondary data set, so I needed no special agreements to access the data. The total sample included 1,545 home health agencies, and 84 agencies were out of scope or ineligible for reasons such as going out of business or merging with some other agency (See CDC, 2015). The 1,036 home health agencies that participated in the survey did so because they were in scope and consented to participate. The agency directors consented on behalf of the agency and the patient records utilized in the survey. The agency directors and staff gave consent for their participation to get interviewed. The researchers did not interview patients or their family members. The study did not include the case when the survey administrator could not gather the necessary permissions. Additionally, the subjects of the secondary dataset were deidentified and coded.

The Walden University IRB approval number for my study is 05-05-21-0669899. The Walden University IRB reviewed the results of my study before publishing. My study's data will be kept on a password-protected laptop for five years and then destroyed. The dissertation chair and I have access to the data. However, the data was publicly available, so no permission was needed for storage, and there are no special requirements for the destruction of the data. The data was not associated with my employment, and there was no conflict of interest related to this study.

Summary

In Section 2, research design and data collection, I outlined the study's quantitative correlational design and the rationale. The study's methodology was related to the secondary data set taken from the 2007 NHHCS survey (See CDC, 2015). The power analysis yielded the appropriate sample size for my study (See Dupont & Plummer, Jr., 2014). I also discussed the study's operationalization, including meaningful definitions. The data analysis plan included employing logistic regression, chi-square, and Fischer's exact test in IBM SPSS Statistics 27 to analyze the data (See Connelly, 2019; Curtis et al., 2016; Walden University, n.d.a., n.d.b). Lastly, in Section 2, threats to validity and ethical procedures were reviewed and considered. In Section 3, I will present the results and findings of the impact of the registered nurse and agency director's level of education and the CDSS on patient safety (staff use of routine video monitoring, staff use of CDSS guidelines).

Section 3: Presentation of the Results and Findings

The purpose of this quantitative correlational study was to determine, during the delivery of telehealth care by a home care agency, to what extent the level of education of the registered nurse, the level of education of the director of the home care agency, and the CDSS, impact patient safety. In Section 2, I provided details of the data collection process of the 2010 version of the 2007 NHHCS, the secondary data set. I shared the time frame for data collection of the secondary data set, descriptive and demographic characteristics of the sample, and described the sample's proportionality to the population. I also discussed the research questions. The research questions and hypotheses were as follows:

RQ1: During the delivery of telehealth care by home care agencies, to what extent do the level of education of the registered nurse, and the level of education of the director of the homecare agency impact patient safety (routine video monitoring)?

> $H_0$1 During the delivery of telehealth care by home care agencies, the level of education of the registered nurse, and the level of education of the director of the homecare agency have no statistically significant relationship to patient safety (routine video monitoring)
>
> $H_1$1 During the delivery of telehealth care by home care agencies, the level of education of the registered nurse, and the level of education of the director of the homecare agency have statistically significant relationships to patient safety (routine video monitoring)

RQ2: During the delivery of telehealth care by home care agencies, to what extent does the CDSS impact patient safety (staff use of CDSS guidelines)?

$H_0$2 During the delivery of telehealth care by home care agencies, the CDSS has no statistically significant relationship to patient safety (staff use of CDSS guidelines)

$H_1$2 During the delivery of telehealth care by home care agencies, the CDSS has a statistically significant relationship to patient safety (staff use of CDSS guidelines)

By the end of Section 3, I show the results of evaluating the three independent variables from the NHHCS: The level of education of the registered nurse (RN), the level of education of the director of the home care agency, and the CDSS, and their relationship to the dependent variable patient safety (measurable by routine video monitoring and staff use of CDSS guidelines; CDC, 2015). Lastly, I summarize the answers to the two research questions.

Data Collection of Secondary Data Set

The NHHCS study used data gathered between August 2007 and February 2008 (See CDC, 2015). An updated version of the dataset became available in 2010. A total of 1,036 Medicare or Medicaid certified hospice or home health agencies participated in the survey. The initial pool of agencies included in the probability sample was 15,000, from which the random sample included 1,545 agencies, and the probability was proportional to size. The final sample of 1,036 agencies included in the 2007 NHHCS was the agencies from the random sample that agreed to participate and were not screened out based on the selection criteria. The data for the survey was collected by in-person interviews with the agency directors and their staff and by reviewing administrative and medical records.

For my study on the relationship between the level of education and patient safety during telehealth care delivery, N = 1,036 agencies, and the sample I studied for RQ1 was n = 224 agencies. For RQ2, the relationship between the CDSS and patient safety during telehealth care delivery, N = 1,036 agencies, and the sample size I studied was n = 406 agencies. The samples for the two analyses were smaller than the total population due to the exclusion of missing cases.

Results

Research Question 1 (RN Nursing Degrees Studied Together with Director Degrees)

RQ1 was "During the delivery of telehealth care by home care agencies, to what extent do the level of education of the registered nurse and the level of education of the director of the homecare agency impact patient safety (routine video monitoring of patient)?" Tables 2 and 3 and Figures 1 through 5 show the sample's descriptive statistics (see Bernstein, 2011; Grande, 2015a).

Table 2

Descriptive Statistics

		SAQ4 - Agency's Director/ Administrator highest degree of any kind	SAQ16(a) - Percent RNs with highest degree of Diploma	SAQ16(b) - Percent RNs with highest degree of Associate Degree	SAQ16(c) - Percent RNs with highest degree of BS/BSN (4 year)	SAQ16(d) - Percent RNs with highest degree of MS/MSN or higher	SAQ84(d) - Routine video monitoring of patient
N --------------	Valid	993	923	923	923	925	242
	Missing	43	113	113	113	111	794
Mean		11.04	11.45	56.62	27.42	2.88	.15
Std. Error of Mean		.548	.608	1.021	.783	.190	.023
Median		9.00	.00	60.00	25.00	.00	.00
Mode		6	0	100	0	0	0
Std. Deviation		17.259	18.477	31.023	23.786	5.779	.361
Variance		297.887	341.408	962.433	565.760	33.392	.130
Skewness		4.176	1.858	-.290	.719	2.359	1.941
Std. Error of Skewness		.078	.080	.080	.080	.080	.156
Kurtosis		16.633	2.692	-.955	-.373	5.139	1.782
Std. Error of Kurtosis		.155	.161	.161	.161	.161	.312
Range		90	70	100	80	25	1
Minimum		1	0	0	0	0	0
Maximum		91	70	100	80	25	1
Percentiles	25	6.00	.00	33.00	6.00	.00	.00
	50	9.00	.00	60.00	25.00	.00	.00
	75	11.00	17.00	80.00	42.00	3.00	.00

Table 3

SAQ4 - Agency's Director/ Administrator Highest Degree of any Kind

	Group	N	Percent	Name of Degree
	1	59	5.7%	Diploma Degree in Nursing
	2	165	15.9%	Associates Degree in Nursing
	3	3	0.3%	Associates Degree in Health Care Administration
	4	6	0.6%	Associates Degree (Other Health Related)
	5	8	0.8%	Associates Degree (Not Health Related)
	6	195	18.8%	Bachelors Degree in Nursing
	7	16	1.5%	Bachelors Degree in Health Care Administration
	8	43	4.2%	Bachelors Degree (Other Health Related)
	9	93	9.0%	Bachelors Degree (Not Health Related)
	10	107	10.3%	Masters Degree in Nursing
	11	70	6.8%	Masters Degree in Health Care Administration
	12	63	6.1%	Masters Degree (Other Health Related)
	13	100	9.7%	Masters Degree (Not Health Related)
	14	23	2.2%	Doctorate Level Degree (E.G., MD, PHD, JD)
	91	42	4.1%	Other
Missing	-8	1	0.1%	
	-1	42	4.1%	
	Total	1036	100.0%	

Figure 1

SAQ4 – Agency's Director/Administrator Highest Degree of Any Kind

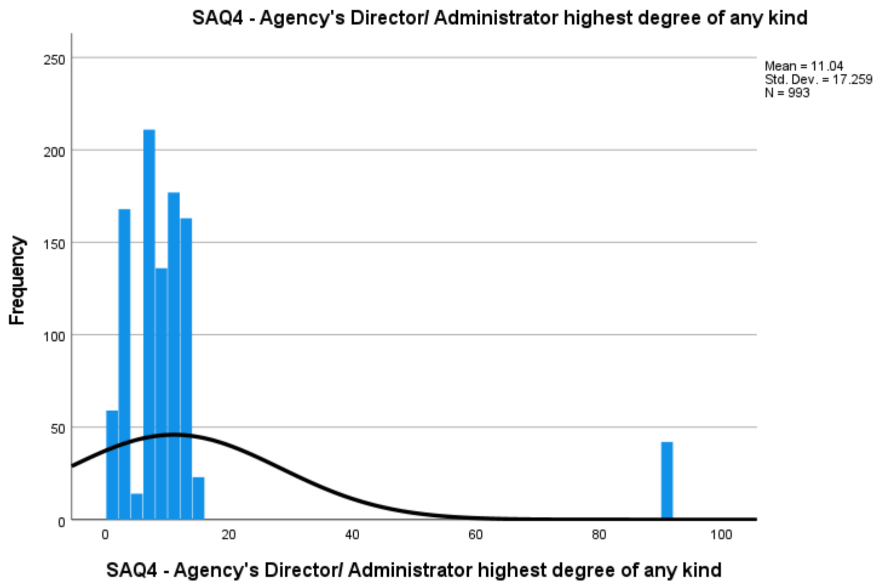


Figure 2

SAQ16(a) – Percent RNs with Highest Degree of Diploma

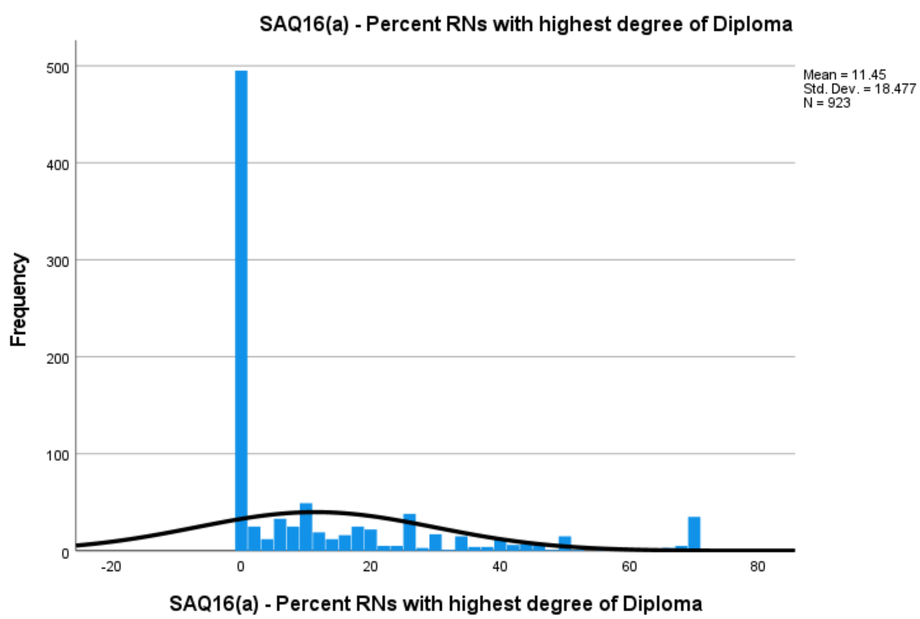


Figure 3

SAQ16(b) – Percent RNs With Highest Degree of Associate Degree

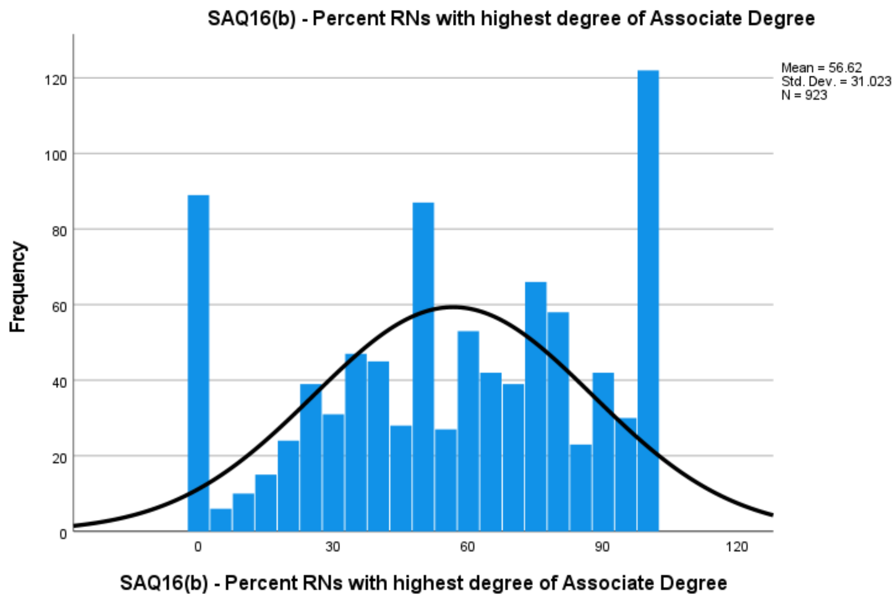


Figure 4

SAQ16(c) – Percent RNs With Highest Degree of BS/BSN (4 Years)

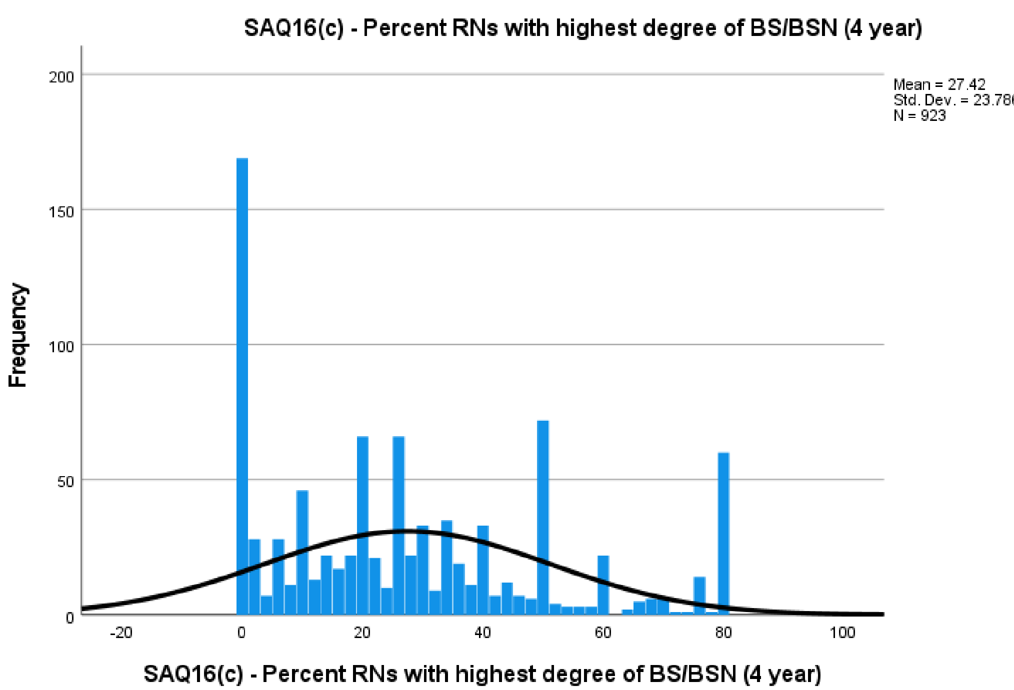
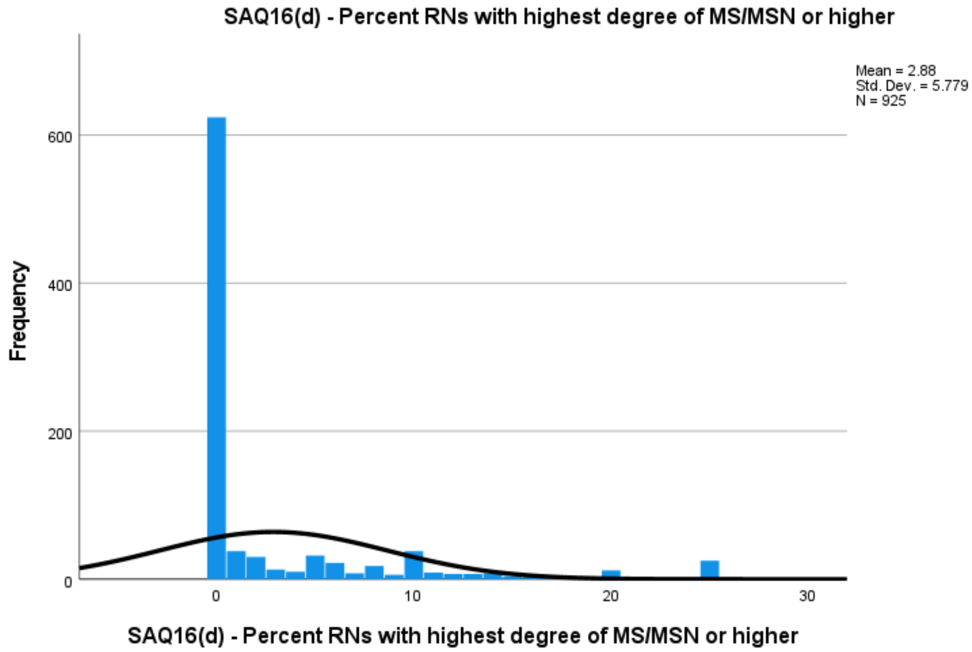


Figure 5

SAQ16(d) – Percent RNs with Highest Degree of MS/MSN or Higher



Chi-Square

Chi-square and descriptive results show an overview of the data. The chi-square test shows likely outcomes one may find in the logistic regression results (See Grande, 2016a). Response one represents a yes response, and response zero reflects a no response in the recoded dependent variable (See BrunelAsk, 2015). Additionally, I recoded missing values to discrete values such as -1, -7, and -8, and recoded string values to numeric values to assist with running the chi-square and later the logistic regression (See Grande, 2015b, 2015c). Lastly, I used the IBM SPSS NMISS function to exclude the missing data for independent and dependent variables (See Arikawa, 2020).

The Pearson chi-square shown in Table 4 was statistically significant ($p < .05$). Additionally, based on the crosstabs and case processing summary shown in Table 5 and

Table 6, out of a possible 241 agency cases (total count of yes for all agency director groups was 37, total agency director count of 204), the agency directors were further classified in a total of 14 applicable educational level groups ranging from diploma in nursing to a doctorate level education of any kind. Out of a possible 224 agency cases (total agency count of yes for all RN groups was 35, total agency RN count of no was 189), the classification of the RN included a total of 275 groups, broken down into percentile categories of the highest degree of diploma (70 groups), associate (100 groups), bachelor's (80 groups), or master's level education (25 groups; Grande, 2016b). Also, response one is indicative of a yes response, and response zero is indicative of a no response.

According to the results shown in the chi-square crosstab in Table 5, the across group comparison of agency director's level of education (a total of 14 groups of education levels), the most substantial likelihood of no to routine video monitoring was for the agency directors in group 6, bachelor's degree in nursing, with 48 no outcomes (total likelihood of no for all agency's director groups was 204; Grande, 2016b). That is, 94.1% of the agency directors with a bachelor's degree in nursing would likely not use routine video monitoring. The most substantial likelihood of yes for routine video monitoring was for the agency directors in group 13, master's degree (not health-related) with 14 yes outcomes (total yes for all agency's director groups was 37). That is, 50% of the agency directors with the highest degree of masters (not health-related) would likely use routine video monitoring, and 50% would likely not use the system (see Grande, 2016b). Also, of note in Table 5, in the within-group comparison of agency directors with the highest degree of any kind, agency directors in group 4, group 7, and group 9 had counts of 0 for yes, and counts of 3, 4, and 16 for no, respectively. That is, the agency directors with an associate degree (other health-related), bachelor's degree in health care administration, and bachelor's degree (not health-related) were 100% less likely to use routine video monitoring of patients. Overall, for agency director/administrator level of education, the most substantial likelihood was for yes to routine video monitoring.

Table 4

Chi-Square Test

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	39.075[a]	12	.000	.[b]		
Likelihood Ratio	35.873	12	.000	.[b]		
Fisher-Freeman-Halton Exact Test	.[b]			.[b]		
Linear-by-Linear Association	.832[c]	1	.362	.441	.201	.004
N of Valid Cases	241					

a. 13 cells (50.0%) have expected count less than 5. The minimum expected count is .46.

b. Cannot be computed because there is insufficient memory.

c. The standardized statistic is .912.

Table 5

*SAQ4 - Agency's Director/Administrator Highest Degree of Any Kind * SAQ84(d) - Routine Video Monitoring of Patient Crosstab*

		SAQ84(d) - Routine video monitoring of patient		
		0	1	Total
SAQ4 - Agency's Director/Adminis-trator highest degree of any kind (Bachelor's degree in nursing)	Group 6 Count	48	3	51
	Expected Count	43.2	7.8	51.0
	% within SAQ4 - Agency's Director/ Administrator highest degree of any kind	94.1%	5.9%	100.0%
	% within SAQ84(d) - Routine video monitoring of patient	23.5%	8.1%	21.2%
	% of Total	19.9%	1.2%	21.2%
SAQ4 - Agency's Director/ Administrator highest degree of any kind (Master's degree, not health-related)	Group13 Count	14	14	28
	Expected Count	23.7	4.3	28.0
	% within SAQ4 - Agency's Director/ Administrator highest degree of any kind	50.0%	50.0%	100.0%
	% within SAQ84(d) - Routine video monitoring of patient	6.9%	37.8%	11.6%
	% of Total	5.8%	5.8%	11.6%
SAQ4 - Agency's Director/ Administrator highest degree of any kind	Total Count	204	37	241
	Expected Count	204.0	37.0	241.0
	% within SAQ4 - Agency's Director/ Administrator highest degree of any kind	84.6%	15.4%	100.0%
	% within SAQ84(d) - Routine video monitoring of patient	100.0%	100.0%	100.0%
	% of Total	84.6%	15.4%	100.0%

Table 6

Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
SAQ4 - Agency's Director/ Administrator highest degree of any kind * SAQ84(d) - Routine video monitoring of patient	241	23.3%	795	76.7%	1036	100.0%
SAQ16(a) - Percent RNs with highest degree of Diploma * SAQ84(d) - Routine video monitoring of patient	224	21.6%	812	78.4%	1036	100.0%
SAQ16(b) - Percent RNs with highest degree of Associate Degree * SAQ84(d) - Routine video monitoring of patient	224	21.6%	812	78.4%	1036	100.0%
SAQ16(c) - Percent RNs with highest degree of BS/BSN (4 year) * SAQ84(d) - Routine video monitoring of patient	224	21.6%	812	78.4%	1036	100.0%
SAQ16(d) - Percent RNs with highest degree of MS/MSN or higher * SAQ84(d) - Routine video monitoring of patient	224	21.6%	812	78.4%	1036	100.0%

According to the results shown in the chi-square crosstab in Table 7, in the across diploma groups comparison (total of 70 diploma groups), the most substantial likelihood of no for routine video monitoring was for RN group 0, 0% RNs with highest degree diploma, with 84 no outcomes (total likelihood of no for all agency's RN groups was 189) (See Grande, 2016b). That is, 84.4% of group 0 RNs with the highest degree diploma would likely not use routine video monitoring. The most substantial likelihood of yes for routine video monitoring was also for group 0, 0% RNs with highest degree diploma (total count of yes for all agency's RN groups was 35.) That is, 16% of the group 0 RNs with the highest degree of the diploma would likely use routine video monitoring of patients. Also, in the within diploma group comparison, RN group 27 and group 36, of percent RNs with highest degree diploma, had counts of 1 for yes and zero for no. The RNs in the agencies with 27% and 36% of RNs with the highest degree diploma were 100% more likely to use routine video monitoring of patients. Additionally, as shown in Table 8, the Pearson chi-square and the Fisher-Freeman-Halton exact tests were not statistically significant ($p > .05$).

Table 7

*SAQ16(a) - Percent RNs with Highest Degree of Diploma * SAQ84(d) - Routine Video Monitoring of Patient Crosstab*

			SAQ84(d) - Routine video monitoring of patient		
			0	1	Total
SAQ16(a) - Percent RNs with highest degree of Diploma (0%)	Group 0	Count	84	16	100
		Expected Count	84.4	15.6	100.0
		% within SAQ16(a) - Percent RNs with highest degree of Diploma	84.0%	16.0%	100.0%
		% within SAQ84(d) - Routine video monitoring of patient	44.4%	45.7%	44.6%
		% of Total	37.5%	7.1%	44.6%
SAQ16(a) - Percent RNs with highest degree of Diploma		Total Count	189	35	224
		Expected Count	189.0	35.0	224.0
		% within SAQ16(a) - Percent RNs with highest degree of Diploma	84.4%	15.6%	100.0%
		% within SAQ84(d) - Routine video monitoring of patient	100.0%	100.0%	100.0%
		% of Total	84.4%	15.6%	100.0%

Table 8

Chi-Square Test

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	41.968[a]	41	.429	.437		
Likelihood Ratio	43.094	41	.382	.416		
Fisher-Freeman-Halton Exact Test	39.693			.369		
Linear-by-Linear Association	3.248[b]	1	.071	.070	.029	.001
N of Valid Cases	224					

a. 77 cells (91.7%) have expected count less than 5. The minimum expected count is .16.

b. The standardized statistic is -1.802.

The chi-square and crosstabs total for percent RNs with highest degree of associate degree are shown in Table 9 and Table 10. As shown in Table 9, group 50 (agencies with 50% RNs with the highest degree of associate degree) showed the highest count of no responses (19). Each of the 100 groups yielded similar yes counts of between zero and three. However, RNs in the associate degree groups 17, 44, 66, 69, 73, 74, 77, 79, and 96 had higher counts of yes over no. That is the agencies with 17%, 44%, 66%, 69%, 73%, 74%, 77%, 79%, and 96% of RNs with the highest degree of an associate degree were 100% more likely to use routine video monitoring (See Grande, 2016b). Additionally, as shown in Table 10, the Pearson chi-square and the Fisher-Freeman-Halton exact tests were statistically significant ($p < .05$).

Table 9

*SAQ16(b) - Percent RNs with Highest Degree of Associate Degree * SAQ84(d) - Routine Video Monitoring of Patient Crosstab*

			SAQ84(d) - Routine video monitoring of patient		
			0	1	Total
SAQ16(b) - Percent RNs with highest degree of Associate Degree (50%)	Group 50	Count	19	2	21
		Expected Count	17.7	3.3	21.0
		% within SAQ16(b) - Percent RNs with highest degree of Associate Degree	90.5%	9.5%	100.0%
		% within SAQ84(d) - Routine video monitoring of patient	10.1%	5.7%	9.4%
		% of Total	8.5%	0.9%	9.4%
	Total	Count	189	35	224
		Expected Count	189.0	35.0	224.0
		% within SAQ16(b) - Percent RNs with highest degree of Associate Degree	84.4%	15.6%	100.0%
		% within SAQ84(d) - Routine video monitoring of patient	100.0%	100.0%	100.0%
		% of Total	84.4%	15.6%	100.0%

Table 10

Chi-Square Test

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	113.711[a]	75	.003	.002		
Likelihood Ratio	100.223	75	.028	.[b]		
Fisher-Freeman-Halton Exact Test	93.120			.003		
Linear-by-Linear Association	6.182[c]	1	.013	.013	.006	.000
N of Valid Cases	224					

a. 141 cells (92.8%) have expected count less than 5. The minimum expected count is .16.
b. Cannot be computed because there is insufficient memory.
c. The standardized statistic is 2.486.

Chi-square and crosstabs total for percent RNs with highest degree of BS/BSN (4 year) are shown in Table 11 and Table 12. As shown in Table 11, group 0 (agencies with 0% RNs with the highest degree of BS/BSN) showed the highest count of no responses (21). Each of the 80 groups yielded similar yes counts of between zero and three. However, RNs in the highest degree BS/BSN groups 26, 51, and 57 had higher counts of yes over no. With 26%, 51%, and 57% of RNs with the highest degree BS/BSN, the agencies were 100% more likely to use routine video monitoring (See Grande, 2016b). Additionally, as shown in Table 12, the Pearson chi-square was not statistically significant ($p > .05$).

Table 11

*SAQ16(c) - Percent RNs With Highest Degree of BS/BSN (4 Years) * SAQ84(d) - Routine Video Monitoring of Patient Crosstab*

			SAQ84(d) - Routine video monitoring of patient		
			0	1	Total
SAQ16(c) - Percent RNs with highest degree of BS/BSN (4 year) (0%)	Group 0	Count	21	1	22
		Expected Count	18.6	3.4	22.0
		% within SAQ16(c) - Percent RNs with highest degree of BS/BSN (4 year)	95.5%	4.5%	100.0%
		% within SAQ84(d) - Routine video monitoring of patient	11.1%	2.9%	9.8%
		% of Total	9.4%	0.4%	9.8%
	Total	Count	189	35	224
		Expected Count	189.0	35.0	224.0
		% within SAQ16(c) - Percent RNs with highest degree of BS/BSN (4 year)	84.4%	15.6%	100.0%
		% within SAQ84(d) - Routine video monitoring of patient	100.0%	100.0%	100.0%
		% of Total	84.4%	15.6%	100.0%

Table 12

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	67.115[a]	55	.127	.[b]		
Likelihood Ratio	62.530	55	.226	.[b]		
Fisher-Freeman-Halton Exact Test	.[b]			.[b]		
Linear-by-Linear Association	1.318[c]	1	.251	.254	.126	.002
N of Valid Cases	224					

a. 101 cells (90.2%) have expected count less than 5. The minimum expected count is .16.

b. Cannot be computed because there is insufficient memory.

c. The standardized statistic is -1.148.

According to the results shown in the chi-square and crosstab in Table 13 and Table 14, in the between-group comparison, the likelihood of no for routine video monitoring was also highest for another RN group 0, agencies with 0% RNs with the highest degree of MS/MSN or higher, showed 17 yes and 105 no outcomes (total yes for all agency's RN groups was 35, total no 189.) That is, in group 0, 13.9% of RNs with the highest degree of MS/MSN or higher would likely use routine video monitoring of patients versus 86.1% likely would not use routine video monitoring (See Grande, 2016b). Also, in the within-group comparison of RNs with the highest degree of MS/MSN or higher, no counts were higher in most other groups. There were two exceptions, group 9 and group 17 (count of one yes and one no.) The RNs in the agencies with 9% or 17% of RNs with MS/MSN or higher degrees stand a 50/50 chance of using routine video monitoring of patients. Additionally, as shown in Table 13, the Pearson chi-square and the Fisher-Freeman-Halton exact tests were not statistically significant (*p* > .05).

Table 13

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	13.122[a]	21	.904	.892		
Likelihood Ratio	15.406	21	.802	.912		
Fisher-Freeman-Halton Exact Test	14.054			.847		
Linear-by-Linear Association	1.287[b]	1	.257	.263	.130	.007
N of Valid Cases	224					

a. 33 cells (75.0%) have expected count less than 5. The minimum expected count is .16.

b. The standardized statistic is -1.134.

Table 14

*SAQ16(d) - Percent RNs With Highest Degree of MS/MSN or Higher * SAQ84(d) - Routine Video Monitoring of Patient Crosstab*

			SAQ84(d) - Routine video monitoring of patient		
			0	1	Total
SAQ16(d) - Percent RNs with highest degree of MS/MSN or higher (0%)	Group 0	Count	105	17	122
		Expected Count	102.9	19.1	122.0
		% within SAQ16(d) - Percent RNs with highest degree of MS/MSN or higher	86.1%	13.9%	100.0%
		% within SAQ84(d) - Routine video monitoring of patient	55.6%	48.6%	54.5%
		% of Total	46.9%	7.6%	54.5%
	Total	Count	189	35	224
		Expected Count	189.0	35.0	224.0
		% within SAQ16(d) - Percent RNs with highest degree of MS/MSN or higher	84.4%	15.6%	100.0%
		% within SAQ84(d) - Routine video monitoring of patient	100.0%	100.0%	100.0%
		% of Total	84.4%	15.6%	100.0%

Logistic Regression

The tables beginning with Table 15 displays the logistic regression for RQ1. As shown in the case processing summary in Table 15, the analysis included 223 of the 1,036 agencies after excluding 813 missing cases. Additionally, as displayed in Table 16-encoding, value one is indicative of a yes response, and value zero indicates a no response (See BrunelAsk, 2015).

Table 15

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	223	21.5
	Missing Cases	813	78.5
	Total	1036	100.0
Unselected Cases		0	.0
Total		1036	100.0

a. If weight is in effect, see classification table for the total number of cases.

Table 16

Dependent Variable Encoding

Original Value	Internal Value
0	0
1	1

Block 0: Beginning Block. As shown in the block zero classification in Table 17, 188 agencies were predicted as no to routine video monitoring and 35 as yes.

Table 17

Classification Table

	Observed		Predicted: SAQ84(d) - Routine video monitoring of patient 0	Predicted: SAQ84(d) - Routine video monitoring of patient 1	Percentage Correct
Step 0	SAQ84(d) - Routine video monitoring of patient	0	188	0	100.0
		1	35	0	.0
	Overall Percentage				84.3

a. Constant is included in the model.

b. The cut value is .500

As shown in the step 0 variables in the equation output in Table 18, the variables were statistically significant ($p < .05$). This output was favorable for the regression analysis (See Grande, 2016a). Also, as shown in the variables not in the equation in Table 19, RNs with the highest degree of an associate was statistically significant ($p < .05$). (See Walden University, 2019c).

Table 18

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-1.681	.184	83.388	1	.000	.186

Table 19

Variables Not in the Equation

			Score	df	Sig.
Step 0	Variables	SAQ4 - Agency's Director/ Administrator highest degree of any kind	1.731	1	.188
		SAQ16(a) - Percent RNs with highest degree of Diploma	3.329	1	.068
		SAQ16(b) - Percent RNs with highest degree of Associate Degree	6.518	1	.011
		SAQ16(c) - Percent RNs with highest degree of BS/BSN (4 year)	1.424	1	.233
		SAQ16(d) - Percent RNs with highest degree of MS/MSN or higher	1.331	1	.249
	Overall Statistics		9.701	5	.084

Block 1: Method = Enter. As shown in Table 20, the block one chi-square, omnibus tests for model coefficients, the model was not statistically significant (p > .05) (See Crowson, 2018).

Table 20

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	10.145	5	.071
	Block	10.145	5	.071
	Model	10.145	5	.071

As shown in the model summary in Table 21, the independent variables explained 7.7% of the variance in the dependent variable (See Grande, 2016). The Nagelkerke $R2$ =

.077 (the *R*2 reference range is 0 – 1, the closer the value is to 1, the better) and the -2 log-likelihood = 183.677 (See Crowson, 2018; See Walden University, 2019b).

Table 21

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	183.677[a]	.044	.077

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

The Hosmer and Lemeshow test, as shown in Table 22, was not statistically significant (p > .05), the model fitted the data, and the model could not be improved upon (See Crowson, 2018; Walden University, 2019b). That is, p > .05 was favorable to the regression model as the preference for this test was for a not statistically significant result (See Grande, 2016; Crowson, 2018). I assessed that the Hosmer and Lemeshow test was valuable to the study (See Crowson, 2018). See additional information for the Hosmer and Lemeshow test in Table 23 and the classification in Table 24.

Table 22

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	8.534	8	.383

Table 23

Contingency Table for Hosmer and Lemeshow Test

		SAQ84(d) - Routine video monitoring of patient = 0		SAQ84(d) - Routine video monitoring of patient = 1		
		Observed	Expected	Observed	Expected	Total
Step 1	1	22	21.043	0	.957	22
	2	18	20.265	4	1.735	22
	3	20	19.824	2	2.176	22
	4	21	19.451	1	2.549	22
	5	18	19.015	4	2.985	22
	6	21	18.488	1	3.512	22
	7	17	17.894	5	4.106	22
	8	17	18.045	6	4.955	23
	9	17	17.629	6	5.371	23
	10	17	16.346	6	6.654	23

Table 24

Classification Table

			Predicted		
			SAQ84(d) - Routine video monitoring of patient		Percentage
	Observed		0	1	Correct
Step 1	SAQ84(d) - Routine video monitoring of patient	0	188	0	100.0
		1	34	1	2.9
	Overall Percentage				84.8

a. The cut value is .500

As reviewed in the chi-square, omnibus tests for model coefficients, the model was not statistically significant ($p > .05$) (See Crowson, 2018). Also, according to the results shown in the step 1 analysis of variables in the equation, the variables were not statistically significant ($p > .05$) based on the *p*-values for each of the independent variables and were not good indicators for group membership (See Crowson, 2018; Grande, 2016a). The predicted membership for this regression analysis was for group 1 (routine video monitoring of the patient). Furthermore, note that odds ratio [Exp(*B*)] values greater than one were indicative that there was no relationship between the independent and dependent variables (See Crowson, 2018). Also, when the Exp(*B*) was greater than one, there was an increase in the odds ratio (See Walden University, 2019c).

The step 1 analysis of variables in the equation displayed the output for Exp(*B*) based on the various levels of RN education (highest education of diploma, associate degree, BS/BSN degree, or MS/MSN degree or higher) and agency director highest degree of any kind. The variables agency director's highest degree of any kind, RNs with the highest degree of associate, and RNs with the highest degree of BS/BSN had Exp(*B*) greater than one. Based on the analysis of variables in the equation, there was an increase in the odds ratio for doing routine video monitoring as the agency director highest degree of any kind increased ($B = .019$, Exp(B) = 1.019) (as the number of this degree increased, odds of routine video monitoring increased) (See Walden University, 2019c). Also, there was an increase in the odds ratio for doing routine video monitoring as the RNs with the highest degree of associate degree increased ($B = .025$, Exp(B) = 1.025) (as the number of this degree increased, odds of routine video monitoring increased) (See Walden University, 2019c). Lastly, there was an increase in the odds ratio for doing routine video monitoring as the RNs with the highest degree of BS/BSN (4 years) increased ($B = .016$, Exp(*B*) = 1.016) (as the number of this degree increased, odds of routine video monitoring increased) (See Walden University, 2019c). An alternate interpretation of Exp(*B*) based on the step 1 analysis of the variables in the equation was that agency directors with the highest degree of any kind were 1.019 times (1.9%) more likely to do routine video monitoring (See Grande, 2016b). Also, RNs with the highest degree associates and RNs with the highest degree BS/BSN were 1.025 times (2.5%) and 1.016 times (1.6%), respectively, more likely to do routine video monitoring (See Grande, 2016).

Conversely, odds ratio [Exp(*B*)] values less than one were indicative that there was a relationship between the independent and dependent variables (See Crowson, 2018). Also, when the Exp(*B*) was less than one, there was a decrease in the odds ratio (See Walden University, 2019c). As shown in the Step 1 analysis of variables in the equation, RNs with the highest degree of diploma and RNs with the highest degree MS/MSN or higher had Exp(*B*) less than one. That is, there was a decrease in the odds ratio for doing routine video monitoring as the number of RNs with the highest degree of diploma increased (*B* = -.004, Exp(*B*) = .996) (as the number of this degree increased, the odds of routine video monitoring decreased) (See Walden University, 2019c). Also, there was a decrease in the odds ratio for doing routine video monitoring as the number of RNs with the highest degree of MS/MSN or higher increased (*B* = -.023, Exp(*B*) = .977) (as the number of this degree increased, the odds of routine video monitoring decreased) (See Walden University, 2019c). An alternate view of the results was that the diploma RN was .996 times (.4%) less likely to do routine video monitoring (See Grande, 2016a, 2016b).

Also, the RN with the highest degree of MS/MSN was .977 times (2.3%) less likely to do routine video monitoring.

However, as shown in Figure 6-predicted probability and Table 25-variables in the equation, based on the *p* values for each of the independent variables (p > .05), the variables were not statistically significant and were not good indicators for group membership (See Crowson, 2018; Grande, 2016b). Also, the regression model for this study favored membership to group one or yes to doing routine video monitoring of the patient.

Figure 6

Observed Groups and Predicted Probability

Step Number 1: Observed Groups and Predicted Probabilities

```
      16 +
         I        1 0
         I        1 0 1
F        I        1 0 1         1
R     12 +        0 0 1 1   1  11
E        I        010 1 0   1  11
Q        I        010 0 0 0 1  001
U        I        00000 0 0 1  0011
E      8 +        0000000 0 0  00111
N        I      0 0000000 0 0  00010
C        I    0 0 000000010001 00000
Y        I   00 0 000000000000100000
       4 +  00000100000000000010000011
         I  00000000000000000010000000
         I  00000000000000000000000000
         I  000000000000000000000000000  0                0             1
Predicted ---------+---------+---------+---------+---------+---------+---------+
  Prob:   0       .1        .2        .3        .4        .5        .6        .7
  Group:  00000000000000000000000000000000000000000000000000111111111111111111111

       Predicted Probability is of Membership for 1
       The Cut Value is .50
       Symbols: 0 - 0
                1 - 1
       Each Symbol Represents 1 Case.
```

Table 25

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C. I. for EXP(B) Lower	Upper
Step 1[a]	SAQ4 - Agency's Director/ Administrator highest degree of any kind	.019	.012	2.407	1	.121	1.019	.995	1.044
	SAQ16(a) - Percent RNs with highest degree of Diploma	-.004	.032	.019	1	.891	.996	.935	1.060
	SAQ16(b) - Percent RNs with highest degree of Associate Degree	.025	.032	.596	1	.440	1.025	.962	1.092
	SAQ16(c) - Percent RNs with highest degree of BS/BSN (4 year)	.016	.034	.217	1	.641	1.016	.950	1.087
	SAQ16(d) - Percent RNs with highest degree of MS/MSN or higher	-.023	.050	.209	1	.648	.977	.885	1.079
	Constant	-3.666	3.252	1.270	1	.260	.026		

a. Variable(s) entered on step 1: SAQ4 - Agency's Director/ Administrator highest degree of any kind, SAQ16(a) - Percent RNs with highest degree of Diploma, SAQ16(b) - Percent RNs with highest degree of Associate Degree, SAQ16(c) - Percent RNs with highest degree of BS/BSN (4 year), SAQ16(d) - Percent RNs with the highest degree of MS/MSN or higher.

The conducted logistic regression analysis investigated RQ1, “During the delivery of telehealth care by home care agencies, to what extent do the level of education of the registered nurse and the level of education of the director of the homecare agency impact patient safety (routine video monitoring of patient)?” The predictor variables, level of education of the RN (diploma, associate, bachelor’s, and master’s), and level of education of the agency director (degree of any kind) were tested a priori to verify that there was no violation of the assumption of the linearity of the logit (See Walden University, 2019a). In the logistic regression analysis, the predictor variables, level of education of the RN, and level of education of the agency director were not statistically significant contributors to the model. The predicted probability favored membership to response 1 (yes to routine video monitoring) (See Grande, 2016).

According to the logistic regression analysis for RNs with highest degree of diploma unstandardized Beta weight of the Constant; B = (-.004), SE = .032, $Wald$ = .019, $p > .05$ (See Walden University, 2019a, 2019c). The estimated odds ratio favored a decrease for patient safety (routine video monitoring of patient) of .4% Exp (B) = .996, 95% CI (.935, 1.060) for each one-unit increase of RNs with the highest degree of diploma. Also, according to the logistic regression analysis for RNs with highest degree of MS/MSN or higher unstandardized Beta weight of the Constant; B = (-.023), SE = .050, $Wald$ = .209, $p > .05$. The estimated odds ratio favored a decrease for patient safety (routine video monitoring of patient) of 2.3% Exp (B) = .977, 95% CI (.885, 1.079) each one-unit increase of RNs with the highest degree of MS/MSN or higher.

The logistic regression analysis results for agency director/administrator with highest degree of any kind showed unstandardized Beta weight of the Constant; *B* = (.019), *SE* = .012, *Wald* = 2.407, p > .05. The estimated odds ratio favored an increase for patient safety (routine video monitoring of patient) of 1.9% Exp (*B*) = 1.019, 95% CI (.995, 1.044) each one-unit increase of the level of education of the agency director (See Walden University, 2019a, 2019c). The regression analysis for RNs with highest degree of associate degree unstandardized Beta weight of the Constant; *B* = (.025), *SE* = .032, *Wald* = .596, *p* > .05. The estimated odds ratio favored an increase for patient safety (routine video monitoring of patient) of 2.5% Exp (*B*) = 1.025, 95% CI (.962, 1.092) each one-unit increase of RNs with the highest degree of an associate degree. Also, for RNs with highest degree of BS/BSN (4 year) unstandardized Beta weight of the Constant; *B* = (.016), *SE* = .034, *Wald* = .217, *p* > .05. The estimated odds ratio favored an increase for patient safety (routine video monitoring of patient) of 1.6% Exp (*B*) = 1.016, 95% CI (.950, 1.087) each one-unit increase of RNs with the highest degree of BS/BSN (4 years).

Research Question 1 (RN Nursing Degree Studied Separately with Director Degree)

The research led to studying the nursing degree (diploma, associate, BS/BSN, and MS/MSN) variables again separately along with agency director highest degree of any kind as independent variables. Patient safety (routine video monitoring) remained the dependent variable. The paragraphs below show the results.

Logistic Regression – Diploma RN and Agency Director

A summary of the findings for the diploma degree RN and agency director highest degree of any kind includes that for the diploma RN, the omnibus test was not significant ($p > .05$); Nagelkerke $R2 = .043$; Lemeshow, not significant ($p > .05$); variables in the equation, not significant ($p > .05$), Exp(B) .975, $B = -.025$, CI (.949, 1.002); as the number of diploma RNs increased, routine video monitoring decreased; probability pointed to membership to group 1 (See Crowson, 2018; See Walden University, 2019b). Additionally, according to the data for agency director highest degree of any kind, the variable in the equation was not significant ($p > .05$); Exp(B) 1.016, $B = .015$, CI (.993, 1.039); as the number of agency directors highest degree of any kind increased, routine video monitoring increased; and probability pointed to membership to group 1.

Logistic Regression – Associate Degree RN and Agency Director

Table 26 to Table 36 and Figure 7-predicted probability displays the logistic regression results for RQ1 (represented by associate degree RN and agency director highest degree of any kind studied together). As shown in Table 26-case processing summary, the analysis included 223 of the 1,036 agencies. Additionally, as shown in Table 27-encoding, value one is indicative of a yes response, and value zero indicates a no response (See BrunelAsk, 2015).

Table 26

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	223	100.0
	Missing Cases	0	.0
	Total	223	100.0
Unselected Cases		0	.0
Total		223	100.0

a. If weight is in effect, see classification table for the total number of cases.

Table 27

Dependent Variable Encoding

Original Value	Internal Value
0	0
1	1

Block 0: Beginning Block. As shown in the block zero classification in Table 28, 188 agencies predicted as no to routine video monitoring and 35 as yes.

Table 28

Classification Table

	Observed		Predicted: SAQ84(d) – Routine video monitoring of patient 0	Predicted: SAQ84(d) – Routine video monitoring of patient 1	Percentage Correct
Step 0	SAQ84(d) – Routine video monitoring of patient	0	188	0	100.0
		1	35	0	.0
	Overall Percentage				84.3

a. Constant is included in the model.

b. The cut value is .500

As shown in the step 0 variables in the equation output in Table 29, the variables were statistically significant ($p < .05$). This output was favorable for the regression analysis (See Grande, 2016a). Also, the variables not in the equation shown in Table 30, was indicative that RNs with the highest degree of an associate degree was statistically significant ($p < .05$). (See Walden University, 2019c).

Table 29

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-1.681	.184	83.388	1	.000	.186

Table 30

Variables Not in the Equation

			Score	df	Sig.
Step 0	Variables	SAQ4 – Agency's Director/ Administrator highest degree of any kind	1.731	1	.188
		SAQ16(b) – Percent RNs with highest degree of Associate Degree	6.518	1	.011
	Overall Statistics		8.233	2	.016

Block 1: Method = Enter. As shown in Table 31, the block one chi-square in the omnibus tests for model coefficients, the model was statistically significant ($p < .05$; See Crowson, 2018).

Table 31

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	8.081	2	.018
	Block	8.081	2	.018
	Model	8.081	2	.018

As displayed in the model summary in Table 32, the independent variables explained 6.1% of the variance in the dependent variable (See Grande, 2016a). The Nagelkerke $R2$ = .061 (the $R2$ reference range is 0 – 1, the closer the value is to 1, the better) and the -2 log-likelihood = 185.741 (See Crowson, 2018; Walden University, 2019b).

Table 32

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	185.741[a]	.036	.061

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

The Hosmer and Lemeshow test in Table 33 was not statistically significant ($p >$ .05), the model fitted the data, and the model could not be improved upon (See Crowson, 2018; Walden University, 2019b). That is, $p > .05$ was favorable to the regression model as the preference for this test is for a not statistically significant result (See Grande, 2016a; Crowson, 2018). I assessed that the Hosmer and Lemeshow test was valuable to the study (See Crowson, 2018). See additional information for the Hosmer and Lemeshow test in Table 34 and the classification in Table 35.

Table 33

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	12.116	8	.146

Table 34

Contingency Table for Hosmer and Lemeshow Test

		SAQ84(d) - Routine video monitoring of patient = 0		SAQ84(d) - Routine video monitoring of patient = 1		
		Observed	Expected	Observed	Expected	Total
Step 1	1	20	20.570	2	1.430	22
	2	21	20.020	1	1.980	22
	3	20	19.703	2	2.297	22
	4	18	19.434	4	2.566	22
	5	20	17.380	0	2.620	20
	6	19	18.800	3	3.200	22
	7	16	19.038	7	3.962	23
	8	18	17.637	4	4.363	22
	9	14	16.931	8	5.069	22
	10	22	18.488	4	7.512	26

Table 35

Classification Table

			SAQ84(d) - Routine video monitoring of patient		Percentage
			0	1	Correct
Step 1	SAQ84(d) - Routine video monitoring of patient	0	188	0	100.0
		1	34	1	2.9
	Overall Percentage				84.8

a. The cut value is .500

As shown in the step 1 analysis of variables in the equation in Table 36, the variable RN with the highest degree associate degree was statistically significant ($p < .05$), Exp(B) 1.018, $B = .018$, CI (1.004, 1.032) (See Grande, 2016a). The p-value for the independent variable ($p < .05$) showed that it was a good indicator for group membership (See Crowson, 2018; See Grande, 2016a). Furthermore, note that odds ratio [Exp(*B*)] values greater than one was indicative that there was no relationship between the independent and dependent variables (See Crowson, 2018). Also, when the Exp(*B*) was greater than one, there was an increase in the odds ratio. In this study, as the number of associate degree RNs increased, routine video monitoring increased (See Walden University, 2019c).

As shown in the step 1 analysis of variables in the equation in Table 36, the agency director's highest degree of any kind was not significant ($p > .05$); Exp(*B*) 1.015, $B = .015$, CI (.992, 1.038). The Exp(*B*) was greater than one, so there was an increase in the odds ratio (See Crowson, 2018; Grande, 2016a; Walden University, 2019b). As the number of agency director’s highest degree of any kind increased, routine video monitoring increased. Lastly, as shown in Figure 7, the predicted membership for this regression analysis was for group 1 (yes to routine video monitoring).

Table 36

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C. I. for EXP(B) Lower	Upper
Step 1[a]	SAQ4 - Agency's Director/ Administrator highest degree of any kind	.015	.012	1.605	1	.205	1.015	.992	1.038
	SAQ16(b) - Percent RNs with highest degree of Associate Degree	.018	.007	6.324	1	.012	1.018	1.004	1.032
	Constant	-2.838	.490	33.596	1	.000	.059		

a. Variable(s) entered on step 1: SAQ4 - Agency's Director/ Administrator highest degree of any kind, SAQ16(b) - Percent RNs with highest degree of Associate Degree.

Figure 7

Observed Groups and Predicted Probability

Step Number 1: Observed Groups and Predicted Probabilities

```
      20 +
         I
         I         1 1  1
F        I         001  1
R     15 +         001  0
E        I         0011 0
Q        I         000000    0
U        I      1  000000    0
E     10 +      0  000000    01
N        I      0 1000000    01
C        I      000000000101 01 11 0
Y        I      000000000001100 1000
       5 +      000000000001100 1000 11
         I     0000000000000100 1000 00
         I     000000000000000001000000
         I     00000000000000000000000000                0      1
Predicted ---------+---------+---------+---------+---------+---------+-
  Prob:   0       .1        .2        .3        .4        .5        .6
  Group:  0000000000000000000000000000000000000000000000000111111111111
```

```
Predicted Probability is of
membership for 1.
The Cut Value is .50
Symbols:0 - 0;1 - 1.
Each Symbol represents 1.25
cases. The figure is
truncated between 0 and .1.
```

Logistic Regression – MS/MSN Degree RN and Agency Director

A summary of the findings for the logistic regression for MS/MSN or higher RN and agency director highest degree of any kind included that for MS/MSN or higher RN, the omnibus test was not significant ($p > .05$); Nagelkerke $R2 = .027$; Hosmer Lemeshow test was not significant ($p > .05$); variables in the equation, not significant ($p > .05$); Exp(B) .950, $B = -.051$, CI (.883, 1.022); as the number of MS/MSN or higher RNs increased, routine video monitoring decreased; and probability pointed to membership to group 1 (See Crowson, 2018; Walden University, 2019b). The results of the study on agency director highest degree of any kind revealed that the variable in the equation was not significant ($p > .05$); Exp(B) 1.018, B = .018, CI (.995, 1.043); as the number of agency director highest degree of any kind increased, routine video monitoring increased; and probability pointed to membership to group 1.

Logistic Regression – Nursing Degrees Studied Together Versus Separately

The results of studying the nursing degrees separately and the agency director degree of any kind (as independent variables) were the same as the original regression model in terms of the variables' positive or negative relationship to patient safety, except for the BS/BSN RN. In the model where the variables were run individually, as the number of BS/BSN increased, patient safety decreased. Still, the omnibus test was not significant ($p > .05$) (in the original regression model, as the number of BS/BSN increased, patient safety increased, and the omnibus test was not significant, $p > .05$) (See Crowson, 2018; Walden University, 2019b). Another notable difference with the second round of regression analyses where the nurse education variables were run individually with agency director education as independent variables, was that the omnibus test for RNs with the highest degree associate showed that the model was statistically significant ($p < .05$). The original model with all nurse education variables included was not statistically significant ($p > .05$). Also, for the individual associate degree model, the variables in the equation data showed the highest degree associate as significant ($p < .05$). Remaining the same as the original group model, as the number of RNs with the highest degree associate increased, routine video monitoring increased.

Research Question 2

RQ2 was “During the delivery of telehealth care by home care agencies, to what extent does the CDSS impact patient safety (staff use of CDSS guidelines)?” Table 37 to Table 39, Figure 8, and Figure 9 display the sample's descriptive statistics (See Bernstein, 2011; Grande, 2015a).

Table 37

SAQ80(e) - Clinical Decision Support System (CDSS) Contraindications, Allergies Guidelines, Etc.

		N	%
1		352	34.0%
2		33	3.2%
3		147	14.2%
Missing	-1	504	48.6%
Total		1036	100.0%

Table 38

Descriptive Statistics

		SAQ80(e) - Clinical Decision Support System (CDSS) contraindications, allergies guidelines, etc.	SAQ90(d) - Clinical Decision Support System guidelines
N	Valid	532	446
	Missing	504	590
Mean		1.61	1.41
Std. Error of Mean		.039	.023
Median		1.00	1.00
Mode		1	1
Std. Deviation		.889	.492
Variance		.791	.242
Skewness		.836	.385
Std. Error of Skewness		.106	.116
Kurtosis		-1.214	-1.860
Std. Error of Kurtosis		.211	.231
Range		2	1
Minimum		1	1
Maximum		3	2
Percentiles	25	1.00	1.00
	50	1.00	1.00
	75	3.00	2.00

Figure 8

SAQ80(e) – Clinical Decision Support System (CDSS) Contraindications, Allergies Guidelines, Etc.

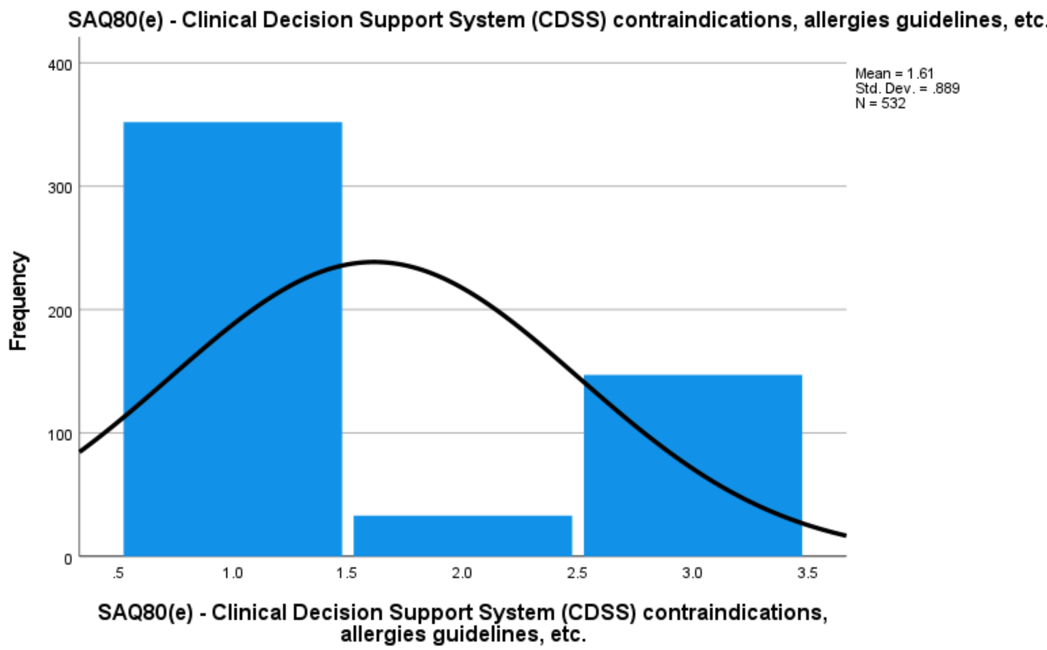


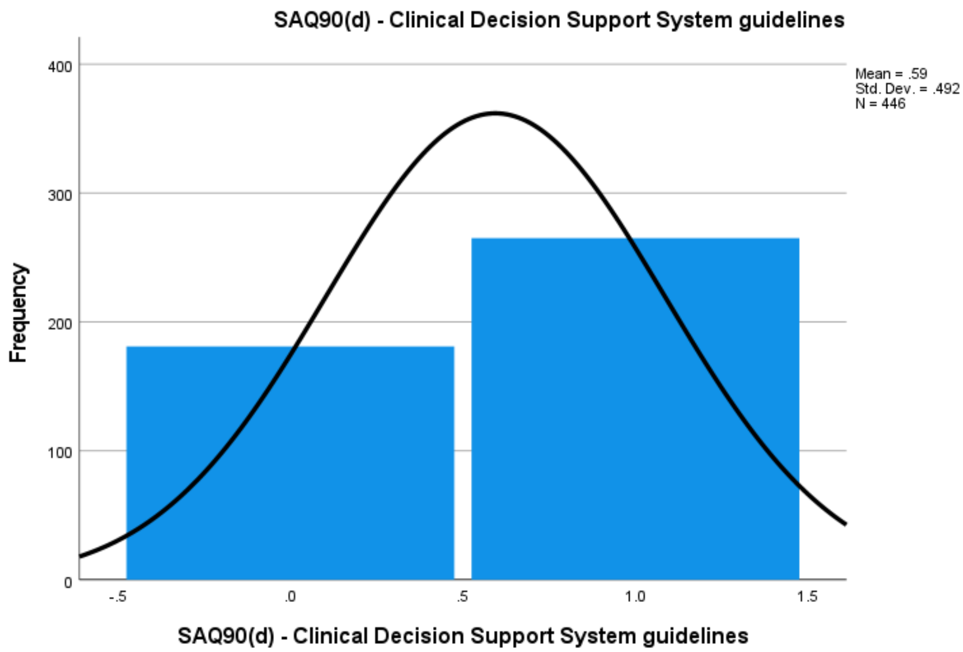
Table 39

SAQ90(d) - Clinical Decision Support System Guidelines

		N	%
0		181	17.5%
1		265	25.6%
Missing	-8	1	0.1%
	-1	589	56.9%
Total		1036	100.0%

Figure 9

SAQ90(d) – Clinical Decision Support System Guidelines



Chi-Square

Chi-square and the descriptive results display an overview of the data. The chi-square test result indicates likely outcomes one may find in the logistic regression results (See Grande, 2016a, 2016b). I recoded the dependent variable so that response one represented a yes response, and response zero reflected a no response (See BrunelAsk, 2015). Additionally, I recoded missing values to discrete values so that -1, -7, -8, and other numeric values replaced string variables to assist with running the chi-square and later the logistic regression (See Grande, 2015b, 2015c). Lastly, I employed the IBM SPSS NMISS function and excluded the missing data for the independent and dependent variables (See Arikawa, 2020).

Based on the case processing summary and crosstab in Table 40 and Table 41, there were 406 valid cases. The dependent variable staff use of CDSS guidelines was classified based on yes (1) or no (0) responses. The independent variable, agency use of CDSS, was classified in a total of three groups (group 1 = agency used, group 2 = available and not used, group 3 = not available.) Total yes for all agencies use of CDSS, 256, and total no, 150. In the between-group comparison and the within-group comparison, the count of the likelihood of agencies utilizing CDSS and staff use of the guideline in the CDSS was higher in group 1, agency used (232 yes, 61 no). If the agency utilized a CDSS, the staff was likely to use the guidelines in the CDSS (See Grande, 2016a). Additionally, as seen in Table 42, the Pearson chi-square and the Fisher-Freeman-Halton exact test were statistically significant ($p < .05$).

Table 40

Crosstabs - Case Processing Summary

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
SAQ80(e) - Clinical Decision Support System (CDSS) contraindications, allergies guidelines, etc.–* SAQ90(d) - Clinical Decision Support System guidelines	406	39.2%	630	60.8%	1036	100.0%

Table 41

*SAQ80(e) - Clinical Decision Support System (CDSS) Contraindications, Allergies Guidelines, Etc. * SAQ90(d) - Clinical Decision Support System Guidelines - Crosstabulation*

		SAQ90(d) - Clinical Decision Support System guidelines					
		0		1		Total	
		N	%N%	N	%		
SAQ80(e) - Clinical Decision Support System (CDSS) contraindications, allergies guidelines, etc.	1	61	40.7%	232	90.6%	293	72.2%
	2	14	9.3%	8	3.1%	22	5.4%
	3	75	50.0%	16	6.3%	91	22.4%
Total		150	100.0%	256	100.0%	406	100.0%

Table 42

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	120.207[a]	2	.000	.000		
Likelihood Ratio	121.597	2	.000	.000		
Fisher-Freeman-Halton Exact Test	120.808			.000		
Linear-by-Linear Association	118.650[b]	1	.000	.000	.000	.000
N of Valid Cases	406					

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.13.

b. The standardized statistic is -10.893.

Logistic Regression

Table 43 to Table 53 and Figure 10-predicted probability display the logistic regression for RQ2. As shown in the case processing summary in Table 43, the analysis included 406 of the 1,036 agencies. Additionally, as shown in Table 44-encoding, value one was indicative of a yes response, and value zero indicated a no response (See BrunelAsk, 2015).

Table 43

Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	406	39.2
	Missing Cases	630	60.8
	Total	1036	100.0
Unselected Cases		0	.0
Total		1036	100.0

a. If weight is in effect, see classification table for the total number of cases.

Table 44

Dependent Variable Encoding

Original Value	Internal Value
0	0
1	1

Block 0: Beginning Block. As shown in the block zero classification in Table 45, the prediction was for 150 agencies with no staff use of CDSS guidelines, and 256 agencies predicted with yes.

Table 45

Classification Table

			Predicted		
			SAQ90(d) - Clinical Decision Support System guidelines		Percentage Correct
	Observed		0	1	
Step 0	SAQ90(d) - Clinical Decision Support System guidelines	0	0	150	.0
		1	0	256	100.0
	Overall Percentage				63.1

a. Constant is included in the model.

b. The cut value is .500

According to the results of the step 0 variables in the equation shown in Table 46, the variables were statistically significant ($p < .05$), and the output was favorable for the regression analysis (See Grande, 2016a). Also, as shown in variables not in the equation in Table 47, the agency use of CDSS was statistically significant ($p < .05$). (See Walden University, 2019c).

Table 46

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	.535	.103	27.025	1	.000	1.707

Table 47

Variables Not in the Equation

			Score	df	Sig.
Step 0	Variables	SAQ80(e) - Clinical Decision Support System (CDSS) contraindications, allergies guidelines, etc.	118.943	1	.000
	Overall Statistics		118.943	1	.000

Block 1: Method = Enter. As shown in Table 48, the block one chi-square for the omnibus tests for model coefficients, the model was statistically significant ($p < .05$) (See Crowson, 2018).

Table 48

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	120.634	1	.000
	Block	120.634	1	.000
	Model	120.634	1	.000

As shown in Table 49-model summary, the independent variable explained 35% of the variance in the dependent variable (See Grande, 2016a). The Nagelkerke $R2$ = .351 (the $R2$ reference range is 0 – 1, the closer the value is to 1, the better) and the -2 log-likelihood = 414.203 (See Crowson, 2018; See Walden University, 2019b).

Table 49

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	414.203[a]	.257	.351

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

The Hosmer and Lemeshow test, as shown in Table 50, was not statistically significant ($p > .05$), the model fitted the data, and the model could not be improved upon (See Crowson, 2018; Walden University, 2019b). No statistical significance ($p > .05$) was favorable to the regression analysis (See Grande, 2016a). I assessed the Hosmer and Lemeshow test was valuable to the study (See Crowson, 2018). Table 51 and Table 52 display additional information about the Lemeshow test and the classification.

Table 50

Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	.951	1	.330

Table 51

Contingency Table for Hosmer and Lemeshow Test

		SAQ90(d) - Clinical Decision Support System guidelines = 0		SAQ90(d) - Clinical Decision Support System guidelines = 1		
		Observed	Expected	Observed	Expected	Total
Step 1	1	75	76.069	16	14.931	91
	2	14	11.863	8	10.137	22
	3	61	62.069	232	230.931	293

Table 52

Classification Table

			Predicted		
			SAQ90(d) - Clinical Decision Support System guidelines		Percentage Correct
	Observed		0	1	
Step 1	SAQ90(d) - Clinical Decision	0	89	61	59.3
	Support System guidelines	1	24	232	90.6
	Overall Percentage				79.1

a. The cut value is .500

As stated previously and shown in Table 48, the chi-square for the omnibus tests for model coefficients, the model was statistically significant ($p < .05$), and the output was favorable for the regression analysis (See Crowson, 2018; Grande, 2016a). As shown in Table 53-step 1 analysis of variables in the equation, the variables were statistically significant ($p < .05$) (See Grande, 2016a, 2016b). The *p*-value for the independent variable ($p < .05$) was indicative of group membership (See Crowson, 2018; Grande, 2016a, 2016b). The predicted membership for this regression analysis was for group 1(staff use of the guidelines in the CDSS). Furthermore, note that odds ratio [Exp(*B*)] values less than one were indicative that there was a relationship between the independent and dependent variables (See Crowson, 2018). Also, when the Exp(*B*) was less than one, there was a decrease in the odds ratio (See Walden University, 2019c).

The variable agency usage of the CDSS had Exp(*B*) less than one. That is, there was a decrease in the odds ratio for staff use of CDSS guidelines as agency use of CDSS increased ($B = -1.471$, Exp(B) = .230) (as number agency use of CDSS increased, staff use of CDSS guidelines decreased) (See Walden University, 2019c). Additionally, the agency with CDSS was .230 times more likely to have staff use of CDSS guidelines (See Grande, 2016a, 2016b). Lastly, as shown in Figure 10, the predicted probability and the preferred membership was to group 1 (yes to staff use of the CDSS guidelines.)

Table 53

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C. I. for EXP(B)	
								Lower	Upper
Step 1[a]	SAQ80–I - Clinical Decision Support System (CDSS) contraindications, allergies guidelines, etc.	-1.471	.155	89.899	1	.000	.230	.169	.311
	Constant	2.785	.257	117.658	1	.000	16.198		

a. Variable(s) entered on step 1: SAQ80(e) - Clinical Decision Support System (CDSS) contraindications, allergies guidelines, etc..

Figure 10

Observed Groups and Predicted Probabilities

Step Number 1: Observed Groups and Predicted Probabilities

```
   320 +
       I                                                                 1
       I                                                                 1
F      I                                                                 1
R  240 +                                                                 1
E      I                                                                 1
Q      I                                                                 1
U      I                                                                 1
E  160 +                                                                 1
N      I                                                                 1
C      I                                                                 1
Y      I             1                                                   1
    80 +             0                                                   1
       I             0                                                   0
       I             0                                                   0
       I             0                   0                               0
Predicted ----+---------+----+----+---------+---------+---------+---------+-
  Prob:      .1        .2   .3   .4        .5        .6        .7        .8
  Group: 0000000000000000000000000000000000001111111111111111111111111111111

       Predicted Probability is of Membership for 1
       The Cut Value is .50
       Symbols:     0 - 0
                    1 - 1
       Each Symbol Represents 20 Cases.
       Figure is truncated between 0 and .1, and between .2 and .4.
       However, all symbols/cases are represented.
```

The conducted logistic regression analysis investigated RQ2 “During the delivery of telehealth care by home care agencies, to what extent does the CDSS impact patient safety (staff use of CDSS guidelines)?” The predictor variable, agency use of CDSS, was tested a priori to verify that there was no violation of the assumption of the linearity of the logit (See Walden University, 2019a). The agency usage of CDSS, the predictor variable in the logistic regression analysis, contributed to the model. The predicted probability favored membership to response one (yes to staff use of CDSS guidelines) (See Grande, 2016a, 2016b).

Based on the logistic regression analysis, the unstandardized Beta weight of the Constant; B = (-.1.471), SE = .155, $Wald$ = 89.899, $p < .05$ (See Walden University, 2019a, 2019c). The estimated odds ratio favored a decrease in staff use of CDSS guidelines. Also, the predicted probability favored a decrease Exp (B) = .230, 95% CI (.169, .311) for patient safety (staff use of CDSS guidelines) each one-unit increase of agency use of CDSS.

Summary

Based on the omnibus tests for model coefficients for all independent variables (diploma RN, associate RN, BS/BSN RN, MS/MSN RN, and agency director highest degree of any kind) studied within the same logistic regression, the model for RQ1, was not statistically significant ($p > .05$) (See Crowson, 2018). It is worth reiterating that based on the data for home care agencies, agency directors with the highest degree of any kind, RNs with highest degree associate, and RNs with the highest degree BS/BSN achieved a higher odds ratio for doing routine video monitoring (See Walden University, 2019c). Additionally, based on the chi-square results, there may be benefits to employing the agency director with a master’s degree of any kind as that sub-group was more likely to do routine video monitoring.

The nursing degree independent variables (diploma RN, associate RN, BS/BSN RN, MS/MSN RN) were also studied individually with the agency director's highest degree of any kind in the same logistic regression. The dependent variable remained patient safety (routine video monitoring). One outcome remained consistent between the grouped regression versus the individual nursing degree regressions. That is, as the number of agency directors with the highest degree of any kind increased, patient safety (routine video monitoring) increased. However, the RN with the highest degree associate model resulted in a different outcome from the original model (where all nursing degrees were studied together). According to the variables in the equation, the associate degree variable was statistically significant (See Crowson, 2018). Also, in the associate degree model for RQ1, “During the delivery of telehealth care by home care agencies, to what extent do the level of education of the registered nurse and the level of education of the director of the homecare agency impact patient safety (routine video monitoring of patient)?”, the chi-square test was statistically significant ($p = .02$). Additionally, as the number of RNs with the highest degree associate increased, patient safety (routine video monitoring) increased. Lastly, as the number of agency directors with the highest degree of any kind increased, patient safety (routine video monitoring) increased.

Based on the logistic regression for RQ2, the variables in the equation were statistically significant ($p < .05$) (See Crowson, 2018). Also, based on the chi-square in omnibus tests for model coefficients, the model for RQ2, “During the delivery of telehealth care by home care agencies, to what extent does the CDSS impact patient safety (staff use of CDSS guidelines)?”, was statistically significant ($p = .001$). That is, for each one-unit increase of agency use of CDSS, patient safety (staff use of CDSS guidelines) decreased (See Walden University, 2019a, 2019c).

In Section 3, I presented the study's results and findings, including the data collection of the secondary data set, the recruitment and response rates, and the descriptive demographics of the sample. The results of my study on the relationships between the level of education of the registered nurse, the level of education of the agency director, the CDSS, and patient safety included descriptive data and the logistic regression analyses for the two research questions. In Section 4, I will share the findings' interpretation, the study's limitations, and recommendations. Also, I will discuss the study’s application to professional practice and the implications for social change.

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

Introduction

The purpose of this study was to determine, during the delivery of telehealth care by a home care agency, to what extent the level of education of the registered nurse, the level of education of the director of the home care agency, and the CDSS, impact patient safety.

The study of RQ1 and its results offer insight into a larger question, Will the home care agency see the benefits of investing in master’s degree-prepared RNs? The answer is not necessarily since RNs with the highest degree associate and RNs with the highest degree BS/BSN have the potential to impact patient safety positively. However, there may be benefits to employing the agency director with a degree of any kind and particularly a master’s degree of any kind, as that subgroup was more likely to impact patient safety positively. The results of RQ2, patient safety or staff use of CDSS guidelines decreased for each one-unit increase of agency use of CDSS, were unexpected. However, when taken in context with an understanding of the open system and the concepts from the literature review, it becomes clear why one cannot credit the implementation of a CDSS alone for improvements in patient safety.

Interpretation of the Findings

The framework of the study was the CSTS model (See Monteagudo et al., 2014). Telehealth and patient safety are subsets of a more extensive multidimensional system, or open system, including influences outside the health care system. The relationship between level of education and patient safety (routine video monitoring) is reflected in several layers of the CSTS model. For example, the component layer, which includes people, data collection, processes for care delivery, and the organization (first layer); the entities subsystem, which includes the professionals involved in care delivery, health information, external factors, interventions, and technology (second layer); and the telehealth system (third layer) which cannot operate independently of the other four layers. Based on the study for RQ1, the associate RN model was statistically significant for increasing patient safety with each one-unit increase of associate degree RN. As diploma, BS/BSN, and MS/MSN level RNs increased, patient safety (routine video monitoring) likely decreased in the other agencies. In the literature review, Shulver et al. (2016) posited that the nurse's education level or experience might affect whether algorithms and protocols are adhered to for the promotion of patient safety.

The study results for RQ2 seem unlikely (patient safety or staff use of CDSS guidelines decreased for each one-unit increase of agency use of CDSS). However, when looked at in the context of the CSTS model, the open system of telehealth, the review of the literature, and with the result of RQ1, perhaps the findings of RQ2 are further substantiated. Implementing the CDSS system alone is not sufficient for addressing patient safety. According to Nadim and Singh (2019), effective management entails managing the subsystems' interactions for the overall system's good. Therefore, the telehealth administrator addressing patient safety will need to manage the interactions between the patients, the nursing staff, the CDSS, and the unforeseen circumstances that may impact patient safety. Also, based on the result for RQ1, the associate degree RN had a statistically significant relationship with patient safety, and according to the literature, the nurse's education level or experience may affect whether algorithms and protocols are adhered to for the promotion of patient safety (See Shulver et al., 2016).

Limitations of the Study

An analysis of the study's findings in the context of the theoretical and conceptual framework supports the concept that telehealth is an open system subject to interaction and potential disturbances from the outside environment (See Monteagudo et al., 2014). One limitation of the study is that the results may not transfer to other telehealth areas. Additionally, there were limited comprehensive databases to research patient safety in telehealth. Another limitation of the study was that the public use data file did not facilitate analysis of patient-level data or patient outcomes. Since the patient-level data were not available to the public, it was impossible to analyze further the relationship between the likely decrease in staff use of CDSS guidelines and routine video monitoring with patient outcomes.

Recommendations

An agency’s implementation of the CDSS alone or the use of telehealth modalities does not automatically improve patient safety. The staff needs to be engaged with the CDSS and telehealth workflow to impact patient safety positively. A recommendation for future researchers is to study the specific impact of telehealth modalities on patient outcomes. A limitation of this study was that patient outcomes were not made publicly available in the 2007 NHHCS public-use data file (See CDC, 2015).

Implications for Professional Practice and Social Change

This study's contribution to professional practice and social change is that college-level nursing education should include telehealth and electronic documentation training. According to Shulver et al. (2016), the nurse's education level or experience may affect whether algorithms and protocols are implemented or adhered to for the promotion of patient safety. One recommendation for professional practice is that health care providers such as home health agencies can benefit from hiring trained professionals with an understanding of tools such as CDSS guidelines and routine video monitoring. Another recommendation is to promote staff reeducation. Leaders who support T-B to address patient safety will also need to address staffing (See Morony et al., 2018). Interventions such as staff reeducation and the T-B method ensure that the staff is not only informed that the tools exist, but they may also demonstrate an understanding of how to employ the tools to provide patient care. Training the health care workforce should include comprehensive development and guidance for passing competencies and continuing education (See WHO, 2015). The study's overall impact on social change is at an organizational level. The study highlights the levels of education of the home care nurse and agency director and the benefit of hiring professionals to understand patient safety tools such as CDSS guidelines and routine video monitoring.

Conclusion

The best take-home message that captures the essence of this study is that hiring nurses with the highest level of education does not necessarily lead to the most significant positive impact on patient safety. Instead, the agency-provided patient care tools such as routine video monitoring or CDSS guidelines require agency intervention to inspire staff to utilize the tools while providing patient care. It behooves the industry's leadership to implement protocols to address direct care worker training (See Spetz et al., 2019). According to Breen et al. (2016), staff and patient education and reeducation on the decision support system are necessary to enhance telehealth patient safety. Also, include the T-B training method in the telehealth nurses' orientation process (See Morony et al., 2018). Lastly, according to Hah & Goldin (2019), telehealth technology training in nurse education improves staff confidence in care delivery.

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Appendix A: 2007 National Home and Hospice Care Survey and

National Home Health Aide Survey

2007 National Home and Hospice Care Survey

and

National Home Health Aide Survey

Contents

Description

National Home and Hospice Care Survey

The 2007 National Home and Hospice Care Survey (NHHCS) is one in a continuing series of nationally representative sample surveys of U.S. home health and hospice agencies. It is designed to provide descriptive information on home health and hospice agencies, their staffs, their services, and their patients. NHHCS was first conducted in 1992 and was repeated in 1993, 1994, 1996, 1998, and 2000, and most recently in 2007.

NHHCS, conducted between August 2007 and February 2008, was reintroduced into the field in 2007 after a 7-year break. During that time, the survey was redesigned and expanded to include a computer-assisted personal interviewing (CAPI) system, many new data items, and larger sample sizes of current home health patients and hospice discharges. All agencies that participated in the survey were either certified by Medicare and/or Medicaid or were licensed by a state to provide home health and/or hospice services and currently or recently served home health and/or hospice patients. Agencies that provided only homemaker services or housekeeping services, assistance with instrumental activities of daily living (IADLs), or durable medical equipment and supplies were excluded from the survey. The 2007 NHHCS included a supplemental survey of home health aides employed by home health and/or hospice agencies, called the National Home Health Aide Survey (NHHAS).

The 2007 NHHCS data were collected through in-person interviews with agency directors and their designated staffs; no interviews were conducted directly with patients or their families and/or friends. Agency data collected, available in agency administrative records, included information on the year an agency was established, the types of services an agency provided, referral sources, specialty programs, and staffing characteristics. Data collected on home health patients and hospice discharges, available in medical records, included age, sex, race and ethnicity, services received, length of time since admission, diagnoses, medications taken, advance directives, and many other items. The total number of agencies that participated in the 2007 NHHCS is 1,036, and data are available on 9,416 current home health patients and hospice discharges from these agencies. A detailed methods report on the 2007 NHHCS will be available in the near future on the NHHCS website at http://www.cdc.gov/nchs/nhhcs.htm.

National Home Health Aide Survey

The National Home Health Aide Survey (NHHAS), the first national probability survey of home health aides, was designed to provide national estimates of home health aides employed by agencies that provide home health and/or hospice care. NHHAS was sponsored by the Office of the Assistant Secretary for Planning and Evaluation (ASPE). NHHAS, a multistage probability sample survey, was conducted as a supplement to the 2007 NHHCS. Agencies providing home health and/or hospice care were sampled into NHHCS, and then up to six home health aides were sampled from eligible participating NHHCS agencies. Home health aides were considered eligible to participate in NHHAS if they were 1) directly employed by the sampled agency; and 2) provided assistance in activities of daily living (ADLs), including bathing, dressing, transferring, eating, and toileting. NHHAS was administered to aides during their nonworking hours by interviewers who used a computer-assisted telephone interviewing (CATI) system to collect the data. The survey instrument included sections on recruitment, training, job history, family life, management and supervision, client relations, organizational commitment and job satisfaction, workplace environment, work-related injuries, and demographics. The NHHAS questionnaire was virtually identical to the survey instrument used in the 2004 National Nursing Assistant Survey of certified nursing assistants working in nursing homes, to permit comparisons of direct care workers across long-term care workplace settings. Minor changes were made to account for differences in workplace environment and responsibilities between home health aides and certified nursing assistants. A total of 3,377 interviews of aides working in agencies providing home health and/or hospice care were completed between September 2007 and April 2008. A detailed methods report on the 2007 NHHAS will be available in the near future on the NHHCS website at http://www.cdc.gov/nchs/nhhcs.htm.

Sample Design

NHHCS

The 2007 NHHCS used a stratified two-stage probability sample design. The first stage, carried out by the Centers for Disease Control and Prevention's National Center for Health Statistics (NCHS), was the selection of home health and hospice agencies from the sample frame of over 15,000 agencies, representing the universe of agencies providing home health care and hospice services in the United States. The primary sampling strata of agencies were defined by agency type and metropolitan statistical area (MSA) status. Within these sampling strata, agencies were sorted by census region, ownership, certification status, state, county, ZIP code, and size (number of employees). For the 2007 NHHCS, 1,545 agencies were systematically and randomly sampled with probability proportional to size. A detailed methods report on the 2007 NHHCS will be available in the near future on the NHHCS website at http://www.cdc.gov/nchs/nhhcs.htm.

The second stage of sample selection was completed by the interviewers during the agency interviews. The current home health patients and hospice discharges were randomly selected by a computer algorithm, based on a census list provided by each agency director or his/her designee. Up to 10 current home health patients were randomly selected per home health agency, up to 10 hospice discharges were randomly selected per hospice agency, and a combination of up to 10 current home health patients and hospice discharges were randomly selected per mixed agency. Current home health patients were defined as patients who were on the rolls of the agency as of midnight of the day immediately before the agency interview. The hospice discharges were defined as patients who were discharged from the hospice agency during the 3-month period beginning 4 months before the agency interview. Discharges that occurred because of the death of a sampled hospice patient were included.

NHHAS

NHHAS is a linked establishment and worker survey, similar to the design of the National Nursing Assistant Survey (http://www.cdc.gov/nchs/nnas2004.htm). NHHAS is based on a two-stage probability sample design with the NHHCS agency sampled first and a random selection of aides from each of the participating sampled NHHCS agencies sampled second.

The first stage consisted of the selection of a stratified probability sample of agencies from a sample frame of over 15,000 agencies, representing the universe of agencies providing home health care and hospice services in the United States. The sample frame was stratified by type of services the agency provided and MSA status. Within these primary strata, agencies were sorted by census region, ownership, certification status, state, county, ZIP code, and size (number of employees). Then, 1,545 agencies were systematically and randomly selected with probability proportional to size. A detailed methods report on the 2007 NHHCS will be available in the near future on the NHHCS website at http://www.cdc.gov/nchs/nhhcs.htm.

In the second stage of sampling, a random sample of up to six aides was selected from each agency eligible for and participating in NHHCS. Aides were eligible for the survey if they were directly employed by the agency and provided assistance with ADLs, including eating, toileting, bathing, dressing, and transferring. The aide sampling procedure started with the NHHCS in-person agency interview. During the NHHCS in-person interview with the agency respondent, the agency provided a list of aides who met the eligibility criteria as of midnight of the day immediately before the agency interview. The interviewer numbered the list and entered the total number of aides into the CAPI system used for the NHHCS survey and sampling. The CAPI program, through systematic randomization procedures, selected up to six aides. A total sample of 4,416 aides were sampled and fielded for NHHAS; 4,279 were eligible and 3,377 aides completed NHHAS telephone interviews. A detailed methods report on NHHAS will be available in the near future on the NHHCS website at http://www.cdc.gov/nchs/nhhcs.htm.

Sampling Frame

The sampling frame for the 2007 NHHCS was constructed using three sources: (1) The Centers for Medicare & Medicaid Services Provider of Services file of home health agencies and hospices, (2) State licensing lists of home health agencies compiled by a private organization, and (3) The National Hospice and Palliative Care Organization file of hospices. The combined files were matched and identified duplicates were removed, resulting in a sampling frame of 15,488.

Scope of Survey

NHHCS

For the 2007 NHHCS, a sample of 1,545 agencies was selected. Only agencies providing home health or hospice care services to patients at the time of the survey or recently before the survey were eligible to participate in the NHHCS. Of the 1,545 agencies in the sample, 1,461 (95 percent) were considered in scope. The 84 out-of-scope agencies were ineligible for one or more of the following reasons: did not meet the definition used in the survey, had gone out of business, was a duplicate of another sampled agency, or had merged with other sampled agencies. Of the in-scope agencies, 1,036 agreed to participate, resulting in a first-stage agency unweighted response rate of 71 percent and weighted response rate of 59 percent. A total of 10,009 current home health patients and hospice discharges were sampled from the responding agencies: 5,026 current home health patients and 4,983 hospice discharges. Of these, 106 home health patients and 19 hospice discharges were considered out of scope. Furthermore, 237 current home health patients and 231 hospice discharges were excluded due to one of the following reasons: consent problems, record problems, refusals, ran out of time, and nonresponse. This resulted in 4,683 home health cases and 4,733 hospice cases, for a second-stage unweighted response rate of 95 percent (9,416/9,884) and weighted response rate of 96 percent. For the NHHCS patient health module, the overall unweighted response rate was 66 percent and the overall weighted response rate was 55 percent. Weighted and unweighted response rates are reported per Office of Management and Budget’s (OMB) September 2006 Standards and Guidelines for Federal Statistics. Weighted rates measure the proportion of the total population that is represented by respondents while unweighted rates reflect only the proportion of the sample that responded. A detailed methods report on the 2007 NHHCS will be available in the near future on the NHHCS website at http://www.cdc.gov/nchs/nhhcs.htm.

NHHAS

Of the 1,036 agencies that participated in NHHCS, 52 agencies had no aides to sample, resulting in 984 agencies eligible to participate in NHHAS. Of these 984 agencies eligible for NHHAS, 22 refused to participate, and no aides were sampled at 7 additional agencies because the interviewer ran out of time or was otherwise unable to complete the aide sampling. As a result, aides were sampled from 955 eligible agencies, for an unweighted first-stage NHHAS response rate of 97 percent and a weighted response rate of 97 percent. From the 955 agencies, 4,416 home health aide cases were sampled and fielded. Of the 4,416 cases, 137 (3 percent) were ineligible for one of the following reasons: not employed on the sampling date, did not provide assistance with ADLs, were contract employees, were sampled in error, or were identified as ineligible during the aide interview because the respondent did not know whether she was an employee of the sampled agency. Thus, a total of 4,279 of the sampled cases were eligible and 3,377 aides completed the survey. At the second sampling stage, the unweighted response rate was 79 percent (3,377/4,279) and the weighted response rate was 71 percent (9,895/13,936). The overall unweighted NHHAS response rate was 54 percent (71 percent unweighted response rate for overall agency participation x 97 percent unweighted response rate for agencies participating in the NHHCS that also participated in the NHHAS, by providing a list of home health aides employed by their agency x 79 percent unweighted response rate for home health aides). The overall weighted response rate was 40 percent, using weighted response rates of the same components used to calculate the unweighted response rate (59 percent x 97 percent x 71 percent). Weighted and unweighted response rates are reported per OMB's September 2006 Standards and Guidelines for Federal Statistics. Weighted rates measure the proportion of the total population that is represented by respondents while unweighted rates only reflect the proportion of the sample that responded. A detailed methods report on NHHAS, will be available in the near future on the NHHCS website at http://www.cdc.gov/nchs/nhhcs.htm.

Data Collection Procedures

NHHCS

The 2007 NHHCS was administered in sampled home health and hospice agencies, between August 2007 and February 2008, using a computer-assisted personal interviewing (CAPI) instrument that was loaded onto each interviewer's laptop. CAPI consisted of five modules: Agency Qualifications and Characteristics (AQ), Patient Sampling (PS), Patient Health (PH), Patient Charges and Payments (PA), and Aide Sampling (AS). A self-administered staffing questionnaire was also mailed to the agency directors who were asked to complete it before the in-person agency interview. The AQ module included agency qualifications and characteristics data items. Interviewers were instructed to complete the agency qualifications items first to ensure that the agency was eligible to participate in the survey. Interviewers were then free to administer the agency characteristics in the AQ module and the PS, PH, PA, and AS modules in any order depending on the availability of designated agency staff to answer the survey questions. The PH data items collected information about the health of current home health patients and/or hospice discharges as documented in their medical records. NHHCS also included a first-time supplemental survey of home health aides employed by home health and hospice agencies, the National Home Health Aide Survey (NHHAS).

Data were collected according to the following procedures: (1) An advance package of NHHCS information, including a letter from the NCHS director, was mailed to the director of each sampled agency, informing him/her of the purpose, content, and authorizing legislation of the survey and that he/she would be contacted by telephone to schedule an appointment. The advance package included letters of support from the National Hospice and Palliative Care Organization and from the National Association for Home Care and Hospice. Also included in the package was a copy of an NCHS report–The Use of Computerized Medical Reports in Home Health and Hospice Agencies: United States, 2000–to illustrate how the survey data can be used to present important findings in the industry. (2) After the package was mailed, the interviewer telephoned the sampled agency to speak to the director, explain the survey in further detail, address any questions or concerns about NHHCS, and schedule an in-person interview with the director. (3) After the interviewer successfully scheduled an interview, a confirmation package was mailed to the director. This package included a confirmation letter with details about agency information the interviewer would need to complete the interview, in addition to the self-administered staffing questionnaire that the director was expected to complete by the day of the agency interview. (4) At the in-person agency interview, the interviewer collected the completed staffing questionnaire and administered the AQ module of CAPI. Provided the agency was eligible to participate in the survey, the interviewer sampled up to 10 current home health patients/hospice discharges using the PS module of CAPI. In mixed agencies, a combination of up to 10 current home health patients and hospice discharges were sampled, usually 5 of each; if 5 of either group was not available, the interviewer sampled more from the group that had more than 5 on the census list. The interviewer completed the sampling exercise by cleaning (e.g., identifying and removing duplicate names on a list of current home health patients) and numbering the census lists and entering the total number of current home health patients and/or hospice discharges into CAPI. Subsequently, CAPI randomly selected 10 numbers based on the total number of current patients/hospice discharges that were entered into the computer algorithm. The sampled patients/discharges were those corresponding to the randomly generated numbers in the census list. (5) The interviewer met with designated staffs that were familiar with the sampled patients/discharges and their care and collected information on the survey items in the PH and PA modules for each sampled patient/discharge. The respondents referred to patient medical records, administrative records, and medication administration records to answer the survey items. No patients or families/friends were interviewed directly. (6) The interviewer constructed a census list of currently employed home health aides, selecting up to six home health aides using the procedures described above for sampling patients/discharges, and requested contact information for each sampled home health aide. This information was used for NHHAS.

After the NHHCS data were collected, they were edited to ensure that all responses were accurate, consistent, logical, and complete. The medical information collected in the PH module was coded according to the International Classification of Diseases, 9th Revision, Clinical Modification. One primary admission diagnosis, one current primary diagnosis (or diagnosis at discharge for hospice patients), and up to 15 current secondary diagnoses (or diagnoses at discharge for hospice patients) were collected per current home health patient/hospice discharge. Up to five procedures were collected per sampled patient/discharge.

NHHAS

The 2007 NHHAS was administered by telephone using a computer-assisted telephone interviewing (CATI) system. The questionnaire included 11 modules, the first of which was a screening section to determine eligibility. In addition to the screening module, the questionnaire included modules on recruitment, education and training, job history, family life, management and supervision, client relations, job satisfaction, job rating, work-related injuries, and sociodemographics. Eligible home health aides who were no longer working at the agency when contacted for the telephone interview completed only the sections on eligibility, job history, demographics, and a section not completed by aides who were still working at the agency. This "agency leavers" section included questions on reasons for leaving the job and future plans.

Each home health aide selected for NHHAS received an advance package. The advance package included the following: a letter on NCHS letterhead that described the study, signed by the Director of NCHS with Frequently Asked Questions (FAQs) printed on the back; a $5 bill clipped to the letter signed by the NCHS Director; a welcome letter on NHHAS letterhead; a NHHAS fact sheet; a NHHAS DVD; a NHHAS gift pen; a postcard for the home health aide to indicate willingness to participate in the study and to provide name, address, telephone number and the best time and day to be reached; and a postage-paid return envelope for the postcard. These materials included a toll-free number that aides could call if they were interested in participating in NHHAS. The mode of providing the packages to the home health aides depended on whether the agency provided contact information for the sampled home health aides. If an agency provided address information for its sampled aides, the advance packages were mailed to the home health aides. If an agency did not provide address information for sampled aides, the advance packages were mailed to the agency to be distributed to the sampled aides.

One week after the advance packages were distributed, a reminder letter was sent to the home health aides. If address information was provided, the letter was mailed directly to the home health aides. If address information was not provided, the letters were mailed to the agency to distribute to the home health aides. For home health aides for whom the agency did not provide contact information, a second reminder letter was mailed to the agency 1 week after the first reminder letter to be distributed to the selected home health aides.

Home health aides could indicate interest in participating in NHHAS by returning the postcard, calling the toll-free number listed on the advance package information materials, or by agreeing to participate when a telephone interviewer contacted them. After the NHHAS data were collected, extensive data checking, editing, and coding were performed to ensure that the responses were accurate, consistent, logical, and complete.

Estimation Procedures

Because the statistics from NHHCS and NHHAS are based on a sample, they will differ somewhat from the data that would have been obtained if a complete census had been taken using the same definitions, instructions, and procedures. However, the probability design of NHHCS and NHHAS permit the calculation of sampling errors. The standard error of a statistic is primarily a measure of sampling variability that occurs by chance because only a sample, rather than the entire population, is surveyed. The standard error also reflects part of the variation that arises in the measurement process but does not include any systematic bias that may be in the data or any other nonsampling error. The chances are about 95 in 100 that an estimate from the sample differs from the value that would be obtained from a complete census by less than twice the standard error.

Standard errors can be calculated for agency, patient/discharge, and home health aide estimates using any statistical software package as long as clustering within agencies and other aspects of the complex sample design are taken into account. Software products such as SAS, STATA, and SPSS all have these capabilities. Statistics presented in NCHS publications are computed using SUDAAN software that produces standard error estimates for statistics from complex sample surveys. SUDAAN employs a first-order Taylor Series approximation of the deviation of estimates from their expected values. All three of the NHHCS public-use files (i.e., agency, patient, and medication) and the NHHAS public-use file include design variables that designate each record's stratum marker and the first-stage unit (or cluster) to which the record belongs. The design variables used to estimate characteristics in the patient/discharge file are the same design variables that should be used for the medication data, which were collected at the patient/discharge level.

In the agency public-use file, the variable indicating the stratum of the stratified sampling is STRATUM and the primary sample unit is the observation (i.e., agency) indicated by the variable AGENCYID. The variable representing the population within a stratum for the finite population correction is POPAGY. There are two sample weights: (a) SAMAGYWT for estimates not correlated with agency size, and (b) SIZAGYWT for estimates correlated with agency size (e.g., estimates of total staff across all agencies). The data dictionary for the agency public-use file has a technical section that provides an example of the syntax for using these design variables to describe the sample design in SUDAAN. The NHHCS data dictionary for the agency public-use file is available on the NHHCS website at http://www.cdc.gov/nchs/nhhcs.htm.

The patient and discharge public-use file has two stages. The stratum in the first stage is indicated by the variable PSTRATA in which the primary sample unit is the agency indicated by the variable PTAGYNUM. The variable for the finite population correction in the first stage is POPAGN. In the second stage, the stratum is the variable PHTYPE and the secondary sample unit is the observation (i.e., patient or discharge) indicated by the variable PATNUM. There is no finite population correction in the second stage with the public-use file; thereby the second stage is treated as sampling with replacement. In SUDAAN, to treat the second stage as sampling with replacement the variable POPPAT is used for which the value is -1. In many other statistical packages, not designating a variable for finite population correction at the second stage results in treatment as sampling with replacement. The sample weight is SAMWT. The data dictionary for the patient and discharge public-use file has a technical section that provides an example of the syntax for using these design variables to describe the sample design in SUDAAN. The NHHCS data dictionary for the patient and discharge public-use file is available on the NHHCS website at http://www.cdc.gov/nchs/nhhcs.htm.

The current home health patient sample describes individuals receiving home health care on the night before data collection began and represents home health care utilization on any given day between August 2007 and February 2008. The hospice discharge sample describes the annual number of discharges from hospice care. This design requires the data user to always conduct separate analyses of current home health patients and hospice discharges, using the PHTYPE variable. For current home health patients, PHTYPE=1, and for annual hospice discharges, PHTYPE=2. In order to properly account for the sample design in the calculation of standard errors, both current home health patients and hospice discharges must be used in any analysis. Any analysis should be conducted using the subpopulation command in the statistical software package.

The home health aide public-use file has two stages. The stratum of the first stage is indicated by the variable ASTRATA in which the primary sample unit is the agency indicated by the variable HHAAGYID. The variable for the finite population correction in the first stage is POPAGY. In the second stage, the sample unit is the observation (i.e., the home health aide) indicated by the variable HHAID; there is no stratification at this stage. There is also no finite population correction in the second stage with the public-use file; thereby the second stage is treated as sampling with replacement. In SUDAAN, to treat the second stage as sampling with replacement the variable POPHHA is used in which the value is -1. In many other statistical packages, not designating a variable for finite population correction at the second stage results in treatment as sampling with replacement. The sample weight is SAMWT. The data dictionary for the home health aide public-use file has a technical section that provides an example of the syntax for using these design variables to describe the sample design in SUDAAN.

Because NHHCS and NHHAS are sample surveys and are designed to produce national estimates for agencies, patient/discharges (NHHCS), and home health aides (NHHAS), data analyses must include sampling weights to inflate the sample numbers to national estimates. Each record in the public-use files has a weight for this purpose. By aggregating the weights, national counts can be estimated.

NHHCS estimators take into account the selection procedures of the complete survey design to develop the final sample weight for each sampled agency and each sampled patient/discharge. NHHAS estimators take into account the selection procedures of the complete survey design to develop the final sample weight for each sampled agency and each sampled home health aide. An estimator for any given population total *X* can be expressed as a weighted sum over all sample units, defined as:

$$\hat{X} = \Sigma_u \, x(u)W(u)$$

where u represents a sampled unit, x(u) is the characteristics or response of interest for unit u, and W(u) is the final survey weight for sample unit u. The final weight W(u) for each sampled unit is the product of up to three components:

1. Inverse of the probability of selection (NHHCS and NHHAS)
2. Nonresponse adjustment (NHHCS and NHHAS)
3. Ratio adjustment (NHHCS)

The first component of the weight for each sampled unit (agency, home health patient, hospice discharge) is the inverse of the unit's selection probability. For the home health patient or hospice discharge, the selection probability is the product of two selection probabilities: the probability of selecting the agency to the NHHCS sample and the probability of selecting the current home health patient and/or hospice discharge within the sampled NHHCS agency. The probability of selecting a home health aide is a product of two selection probabilities: the probability of selecting an agency to the NHHCS sample and the probability the home health aide was selected within the sampled NHHCS agency. The inverse of the product of these probabilities is used for weighting.

The first component was modified for sampled agencies found to have multiple listings in the sampling frame after the agency sample was selected. For each agency found duplicated in the sampling frame, the weights of all sampled listings for the agency were summed and divided by the total number of times the agency was found in the sampling frame. To the extent that all listings of each sampled agency are identified in the sampling frame, the resulting weights produce unbiased estimates (that is, estimates that would be obtained if there were no duplicates in the sampling frame).

The second component for calculating the weight is adjustment for nonresponse. This adjustment is made for three types of nonresponse. The first two types are agency level and the third is person level (patient/hospice/aide). The first type occurs when in-scope agencies do not respond to NHHCS. In NHHCS, the second type occurs when an in-scope agency does not provide the number of current home health patients and/or hospice discharges within the respective agency. In NHHAS, the second type of nonresponse occurs when an in-scope agency does not permit survey of their home health aides. The third type occurs when the administrative and medical records of the sampled current home health patients and/or hospice discharges are not made available to complete the survey (NHHCS) or when the sampled home health aide fails to respond (NHHAS).

The third weight component applies only to weights used to estimate numbers of agencies. This component involves ratio adjustments that are made within groups defined by region and agency type to account for use of probability proportional to size when selecting the agency sample. The numerator of the ratio was the number of agencies in the sampling frame within each group and the denominator was the estimated number of agencies for that same group. No ratio adjustment was made to other weights (i.e., agency weights for agency-level estimates for parameters other than numbers of agencies and weights for patients, discharges, or aides). Finally, the weights described above were smoothed within groups defined by region and agency type if there were outlier sample units whose survey weights were somewhat larger than those for the remaining sample in the same group. In smoothing, total estimates for each group were preserved.

Reliability of Estimates

NCHS bases publication of estimates for NHHCS and NHHAS on the relative standard error (RSE)— also known as the coefficient of variation—of the estimate and the number of sampled records on which the estimate is based. The RSE is a measure of variability and is calculated by dividing the standard error (SE) of an estimate by the estimate itself. The result is then converted into a percent by multiplying it by 100. Guidelines used by NCHS authors to determine if estimates should be presented in tables of NCHS published data reports include:

If the estimate is based on fewer than 30 sample cases, then the value of the estimate is not reported. This is usually indicated with an asterisk (*).

If the estimate is based on a sample of 30–59 cases or on 60 or more cases and the RSE is 30 percent or more, then the estimate is reported but should not be assumed reliable. This is usually indicated with an asterisk (*) preceding the figure in the tables.

If the estimate is based on 60 or more sample cases and the RSE is less than 30 percent, then the estimate is reported and is considered reliable.