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Evaluating the 2012 Vaccination Reporting Mandate: Applications to Adventist Health Network

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This is to certify that the doctoral dissertation by

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Abstract

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MPH, Walden University, 2011

BS, Ryerson University, 2006

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Abstract

Influenza is a public health concern that claims up to 56,000 lives annually in the United States, though it is a vaccine-preventable disease. Influenza vaccination among health care personnel (HCP) is highly encouraged to prevent influenza transmission in health care settings. The objective of this study was to examine the relationship between mandatory reporting of HCP influenza vaccination rates (implemented in 2012) and HCP influenza vaccination intake in a health care network with 20 hospitals. The protection and motivation theory was used as the theoretical framework. Data collected from surveys of hospital administrators and archives of the Center for Medicare and Medicaid were used to conduct a retrospective cohort study. Results of a paired-samples *t* test indicated a statistically significant increase in HCP influenza vaccination rates from 63.0% (2010-2013) before to 77.0% (2014-2018) after mandatory reporting was implemented. Bivariate correlation analysis showed that the influenza vaccination means differed significantly between all reported flu seasons. Finally, linear regression of data from the 2015/2016 influenza season indicated that the effectiveness of the organization's strategies (free influenza vaccine, HCP education, establishing a culture of prevention, maintaining up-to-date knowledge with guidelines, and incentivizing HCP through wellness programs) and the hospital size (by number of HCP) were not significant predictors of the vaccination rate. Future studies on mandatory reporting and its relationship to HCP vaccination intake can lead to positive social change by supporting health care policymakers and stakeholders to prevent disease transmission.

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Dedication

I dedicate this dissertation to my husband, Mohammad, and my daughters, Wafaa, Mariam, and Malak, who have each helped in their unique way to support my dreams. This dedication would not be complete without mentioning my parents, Wafaa and Said, who taught me that higher education is the key to a successful life. I thank you all for your patience, courage, and motivation to leave a small positive impact on the world.

Acknowledgments

The pursuit of happiness comes in many shapes and forms. For me, this has been the pursuit of my doctoral degree in Epidemiology. I am thankful for the guidance of my committee members, Dr. Mendelssohn and Dr. Sasser of Walden University, and the generosity of participating Adventist Health network administrators. I want to acknowledge you all for making my pursuit of happiness possible.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction to the Study

Unvaccinated health care personnel (HCP) are at significant risk of both acquiring and spreading the influenza virus in health care settings (Lietz et al., 2009). The risk is amplified by repeated close contact with infected patients. Legislation requiring the mandatory reporting of vaccination rates for health care personnel was enacted in 2012 (Talbot, 2014). This mandate was passed with the intent to improve the annual vaccination rates of HCP and to reach a 90% vaccination goal by the year 2020 (National Vaccine Advisory Committee, 2013). The purpose of this study is to examine if trends in reported HCP vaccination rates have significantly changed since the mandate was passed in 2012 and to identify useful strategies for meeting the Healthy People 2020 vaccination coverage goals.

In this chapter, I present a brief description of influenza vaccination among HCP followed by the purpose of the study, nature of the study, research questions, hypothesis, theoretical framework, and conceptual framework.. This first chapter also includes definitions related to the research variables, assumptions, limitations, and delimitations of the study. This study is the first influenza immunization evaluation study to be conducted in the Adventist Health (AH) network. The findings might be useful for closing the gap of knowledge regarding the influences of mandatory reporting on vaccination rates within the AH network and other health care networks.

According to the World Health Organization (WHO), vaccinations significantly reduce the burden of infectious diseases and may be considered a fundamental human right (WHO, 2013). Evidence is available to suggest that vaccinations have led to significant disease control, as in the case of smallpox (WHO, 2013). Clinical research shows that vaccines are significantly safer than therapeutic medicines and share an excellent safety record (WHO, 2013). Studies of this nature can contribute to social wellbeing by demystifying concerns regarding the influenza vaccination and encouraging coverage in the health care system.

Background

Each year as many as one in five U.S. residents contract the influenza virus. Approximately 200,000 individuals seek medical attention in emergency departments, urgent care, and other medical care facilities for influenza-related illness (CDC, 2013a). The CDC estimates that since 2010, influenza-related hospitalizations have ranged from 140,000 to 710,000, while flu-related deaths have ranged from 12,000 to 56,000 (CDC, 2017). The disease is a highly contagious airborne disease which is transmitted person-to-person by coughing, sneezing, or contact with contaminated environments or objects (WHO, 2013).

Seasonal influenza can cause mild to severe illness and can be fatal, especially in high-risk individuals (WHO, 2013). Influenza infection can occur multiple times because the virus is continuously evolving and changing form (WHO, 2013). Despite the constantly changing structure of influenza, vaccinations are purported by most regulatory agencies to be effective in building the immune system and lowering the likelihood of infection (Bautista et al., 2010). The Advisory Committee on Immunization Practices (ACIP) strongly advocates for the influenza vaccination as essential in preventing influenza and related complications (Miller, et al., 2011).

Nosocomial influenza outbreaks occur in hospitals and other health care environments and have considerable consequences for medical personnel and patients already suffering from other medical conditions (Miller et al., 2011). Since 1984, the Advisory Committee on Immunization Practices (ACIP) has recommended that health care personnel be vaccinated annually to reduce the risk of becoming infected and spreading the infection to vulnerable patient populations (Miller et al., 2011; MMWR, 2013).

The Joint Commission (TJC) is an independent, not-for-profit organization, which accredits and certifies approximately 21,000 health care organizations and programs in the United States (TJC, 2017). The TJC is recognized nationwide as a symbol of quality that reflects an organization's commitment to meeting specific performance standards. Its overarching mission is to continuously improve health care delivered to the public, evaluate health care organizations, and to inspire them to provide safe and effective care of the highest quality and value. TJC also has first-influenza-vaccination programs which propose that health care organizations should reach 90% influenza vaccination coverage by the year 2020. This new requirement, however, does not mandate vaccination for staff as a condition of accreditation.

Since 2003, health care organizations have become more diligent with establishing voluntary influenza vaccination programs for their employees (Healthy People, 2013). Studies have shown that the average influenza vaccination rates among health care professionals have increased from 10% in 1989 to 71% in 2014 (Healthy People, 2013; Riphagen-Dalhuisen et al., 2012). Although the vaccination rate has increased seven-fold within the past 25 years, it remains significantly lower than the Healthy People 2020 goal of 90% vaccination coverage among HCP (Healthy People, 2013).

Problem Statement

Each year, influenza is responsible for an estimated 250,000 to 500,000 deaths worldwide (Miller et al., 2011). Hospital workers and patients are at a disproportionately high risk of acquiring and spreading influenza. A goal of achieving a 90% vaccination rate for health care personnel was prompted by the Center for Medicare and Medicaid Services (CMS), the National Healthcare Safety Network (NHSN), the ACIP, and the Healthcare Infection Control Practices Advisory Committee (HICPAC) (Miller et al., 2011). This goal was to be achieved by initiating a mandatory vaccination reporting requirement for all health care facilities (National Vaccine Advisory Committee, 2013). Despite ongoing recommendations made by regulatory agencies, the immunization rates for health care workers have remained low and are slow to reach optimal levels (National Vaccine Advisory Committee, 2013).

Many hospitals struggle to improve their HCP influenza vaccination rates. Their strategies to encourage vaccination include offering the vaccination free of cost onsite, frequent reminders about the importance of vaccination, and making vaccinations a condition of employment. There is a paucity of published data on the effectiveness of these organizational strategies or the mandate for improving vaccination coverage among HCP (National Vaccine Advisory Committee, 2013). The mandates, as well as different organizational strategies, need to be formally evaluated. Therefore, evaluation of trends in vaccination rates and the relationship of trends to the 2012 mandate served as the foundation of this study. Nonlegislative strategies used by hospitals to maximize vaccination rates were also examined.

Purpose of the Study

This quantitative study evaluated the relationship between reported influenza vaccination rates and the nation-wide reporting mandate introduced in 2012 (National Vaccine Advisory Committee, 2013). It is postulated that mandatory reporting requirements of influenza by hospital facilities could be a force for increasing vaccination and reduce influenza transmission between HCP and their patients. The information gained from this study provided a better understanding of the relationship between the 2012 mandatory reporting legislation and other strategies for maximizing influenza vaccination rates for health care personnel employed by the AH network.

Research Questions and Hypotheses

This research study was conducted to examine whether the mandatory reporting requirements and other organizational strategies are associated with changes in the annual HCP influenza vaccinations reported by the AH network. Data consisted of immunization rates reported by the State Department of Health and the responses to a series of questions collected from the hospital administrators for 20 operating hospitals affiliated with the AH network. Strategies used by each facility for enhancing influenza vaccination uptake were collected from the survey of hospital administrators and compared for effectiveness. The survey allowed participants select from known strategies applied to improve HCP influenza uptake such as influenza immunization as a condition of employment, declination statement for those who decline the vaccine, education session on influenza transmission, or mandatory mask worn during influenza season for unvaccinated HCP. Additional information was also collected in the survey to examine the effectiveness of the strategies used by each hospital and the impact on vaccine intake using participants own judgment of the current stage of the HCP influenza vaccine program.

The research questions and hypothesis statements for this research project are:

RQ1: To what extent, if any, have the influenza immunization rates for HCP employed by the AH network significantly changed since the reporting mandate was introduced in 2012?

$H1_0$: There have been no significant changes in the overall influenza vaccination rates of HCP employed by the AH network since the introduction of mandatory vaccination reporting in 2012.

$H1_a$: There have been significant changes in the overall influenza vaccination rates of HCP employed by the AH network since the introduction of mandatory vaccination reporting in 2012.

RQ2: Are reported influenza vaccination rates comparable between hospitals affiliated with the AH network?

$H2_0$: There are no significant differences in the influenza vaccination rates of HCP between hospitals affiliated with the AH network.

$H2_a$: There are significant differences in the influenza vaccination rates of HCP between Hospitals affiliated with the AH network.

RQ3: Are vaccination rates associated with organizational strategies other than the 2012 reporting mandate?

$H3_0$: There are no significant associations between nonmandate organizational strategies and reported vaccination rates in hospitals affiliated with the AH network.

$H3_a$: There are significant associations between nonmandate organizational strategies and reported vaccination rates in hospitals affiliated with the AH network.

Theoretical Foundation

Several theories, inclusive of the health belief model (HBM), theory of reasoned action (TRA), and subjective expected unity (SEU) could have been used to frame this study because of their value in applying potential motivations towards health protection (Floyd et al., 2000). However, it was determined that the protection and motivation theory (PMT) by Rogers (1975) and Stroebe (2011) was the most suitable theoretical foundation for this study.

The PMT was initially developed by Rogers (1975) to examine the prediction of smoking, traffic safety, and venereal disease. The PMT was revised between 1983 and 1987 to include protection motivation (Stroebe, 2011). This theory has been used to explain health decisions and actions individuals take to protect themselves from a threat . The theory has been applied beyond health care in areas such as information system security procedures (Vance et al., 2012).

The PMT proposes that people protect themselves based on four factors including (a) perceived the severity of a threatening event, (b) perceived probability of the occurrence, (c) efficacy of the recommended preventive behavior, and (d) perceived self-efficacy. The model can be used to explain why people engage in unhealthy practices and offers suggestions for changing those behaviors (Rogers, 1975, 1983). The theory has been applied to calculate the amount of perceived threat, severity, and vulnerability and then subtract the rewards. The use of threat-appraisal has shaped many health initiatives such as anti-smoking and AIDS prevention (Rogers, 1975, 1983).

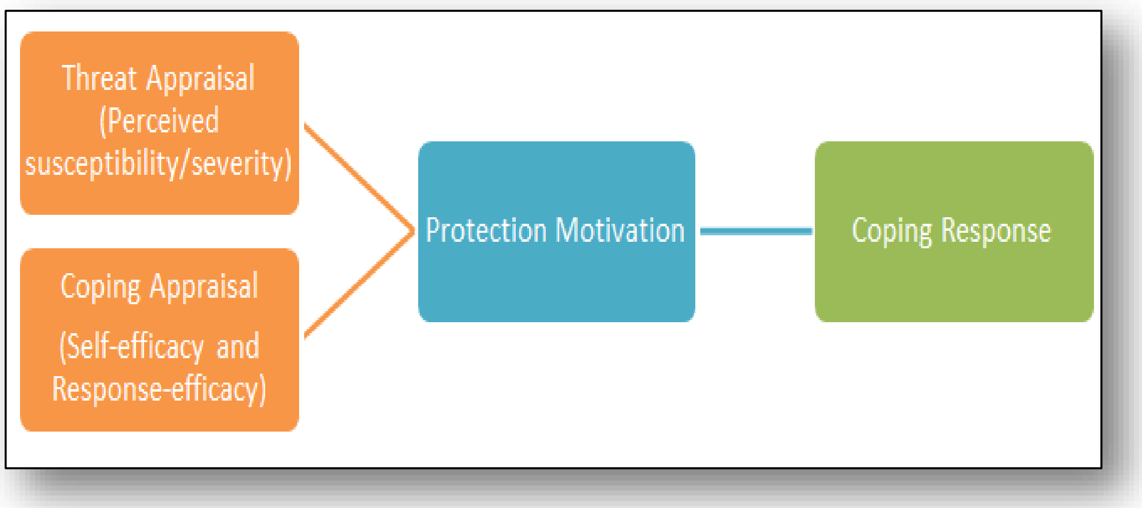
A meta-analysis suggests that among the factors (vulnerability, severity, rewards, response efficacy, self-efficacy, and costs), self-efficacy is the most strongly correlated with protection motivation. PMT has been applied in many different personal health contexts including cancer prevention, diet, and exercise, healthy lifestyle, smoking, AIDS prevention, alcohol consumption, and adherence to medical treatment (Floyd et al., 2000; Milne et al., 2000) .Thus, the protection motivation concept applies to any health threats impacted by individuals or organizations' health recommendations (Floyd et al., 2000).

The first stage of PMT considers sources of information required for assessing the health threat. The second stage involves cognitive mediating processes that apply the threat and coping appraisal toward the protection motivation. The final stage entails the modes of coping where adaptive and maladaptive coping styles take place (Floyd et al., 2000).

The motivation to comply with mandatory reporting and tracking of vaccinations of hospital personnel may be assumed to be associated with a potential threat. The threat appraisal in the situation of mandatory reporting of influenza vaccine aligns with the public reporting aspect of vaccination intake performance. However, the coping appraisal aligns with potential enhanced self-efficacy among HCP. Both may lead to protection motivation either by addressing the mandatory public reporting compliance or vaccination intake depending on HCP. Ultimately, the coping response is what led to the study at hand by examining whether an association exists between mandatory reporting and HCP flu vaccine intake. The PMT is illustrated in Figure 1.

Figure 1

Protection Motivation Theory, Adapted from Rogers, 1983



Nature of the Study

Influenza vaccination is a controversial topic in health care. Vaccination rates among health care workers within one extensive health care network were studied using a quantitative approach. Quantitative methods use objective measurements and numerical analysis of data to classify and measure features, construct statistical models, and attempt to explain what is observed about a particular phenomenon (Creswell, 2003). The goal of quantitative research is to determine the relationship between an independent variable and a dependent or outcome variable within a population. Quantitative research designs can be descriptive, in which subjects are measured once, or experimental, in which subjects are measured before and after treatment. In general, a descriptive study is conducted to establish associations between variables, while an experimental study is conducted to establish causality (Babbie, 2009; Creswell, 2003). In quantitative research, the following characteristics are typically assumed (Babbie, 2009; Creswell, 2003):

- The data are gathered using a structured research instrument.
- The results are representative of a larger population.
- The research study can be replicated or repeated.
- The research questions are clearly defined.
- The study is carefully designed before data is collected.
- Outcomes are analyzed as numbers and statistics.
- Results are arranged in tables, charts, figures, or other non-textual forms.
- Results can be used to generalize concepts and investigate causal relationships.

Data for this study were collected through a combination of data reported to the Department of Public Health between 2014 and 2018 and a short survey given to hospital administrators. The quantitative analysis relied on three tests, including: (a) paired samples *t* test, (b) repeated-measures analysis of variance (ANOVA), and (c) multiple linear regression.

This first part of the analysis was done through a paired samples *t* test. A paired samples *t* test of difference is conducted to compare the mean difference between two related groups or paired difference on the same continuous dependent variable (actual rate of influenza immunization rates for HCP). The mean difference will be compared between four premandatory seasons (2010/2011, 2011/2012, 2012/2013, and 2013/2014) and four postmandatory seasons (2014/2015, 2015/2016, 2016/2017, and 2017/2018). The aim was to evaluate the change in the HCP vaccination rate pre-versus post-mandate and post-mandate overtime.

The second analysis was done utilizing a repeated measures ANOVA of immunization data reported to the CMS between 2010 and 2016. Significant fluctuations in immunization trend data were examined over time. This analysis is considered longitudinal, which differs from cross-sectional analysis because a series of observations are made on the study population over some time. The repeated measures ANOVA can test for significant changes over time. This type of analysis is used to test the overall differences between related means. The dependent variable (reported HCP vaccination rates) was continuous, and the independent variable (season) was a categorical variable.

The second analysis relied on cross-sectional data acquired through one survey conducted at one point in time. Responses were reported as descriptive data, including frequencies, percentages, means, and standard deviations. In medical research, a cross-sectional analysis is a type of observational study that analyzes data collected from a sample at one specific point in time to provide data on the population under study. Cross-sectional studies are used to describe outcomes and may support the inferences of cause and effect. By comparison, a time series or longitudinal analysis traced behaviors either retrospectively or prospectively through a more extended period (Babbie, 2009; Creswell, 2003). A cross-sectional survey provides data for the researcher to observe what is happening without interfering. The observational data are collected from a sample at a specific point in time.

The final part of the analysis examined the strength and direction of the relationship between the dependent variable of vaccination rates and independent variable of non-mandated organizational strategies. This was measured using the responses offered in the survey for intervention and number of HCP per facility using multiple linear regression. Additional variables can influence the relationship between the independent and dependent variables being examined but they are not the variables of interest to this study.

The final analysis of data used a combination of cross-sectional (one-period) and longitudinal (over time) analyses to gain a clearer understanding of how legislation, beliefs, and organizational practices may be related to vaccination rates. However, the analysis of data was not adjusted for multiple comparisons, as will be discussed in more detail in Chapter 3.

Population

The study population consists of hospitals currently operating as part of the AH network. The Seventh-day Adventist Church founded the network in 1973 (Wayback Machine, Adventist.org, 2015). The heritage of the AH network dates back to 1866, however, when the Church opened the first health care facility in Battle Creek, Michigan. Consistent with its religious values and health heritage, concepts held by the church were considered “radical” for the time. The Adventists focus on proper nutrition, exercise, and sanitation, and believe in the prevention of disease and treatment the whole person -

mind, body, and spirit. Hospitals have long been regarded not only as facilities for the healing arts but also as places where patients and their families can learn to be well. The Adventist Church encourages responsible immunization and vaccination and has no religious or faith-based reason not to encourage participation in protective and preventive immunization programs. The church values the health and safety of the community and population at large.

A century and a half after establishing its first health care network, the Seventh Day Adventist Church now operates AH networks with regional divisions (Wayback Machine, Adventist.org, 2015). The AH network under study is located in the western states of California, Hawaii, Oregon, and Washington. In 2022, this not-for-profit health care organization has 21 operational hospitals, approximately 3,000 beds, 19,000 employees, and dozens of affiliated clinics, outpatient centers, home care facilities, and retirement centers. The regional network is headquartered in Roseville California and is not affiliated with the AH networks based in Maryland or Florida.

Sample

The vaccination rates for hospitals are public information. Therefore, data for the repeated measures ANOVA were acquired from the State Department of Health. Participation in the survey component is entirely voluntary and cannot be guaranteed. The sample size is defined as the number of completed responses provided by hospital administrators. I used G*Power software to calculate the required sample size for this study to detect true differences in the data if it exists. G*Power is a power analysis program that is capable of conducting a-priori analyses to determine how many subjects are necessary to calculate the optimum sample size for a variety of statistical procedures (Kadam & Bhalerao, 2010). A power of 0.80 is typically used in quantitative research projects to provide valid statistical results (Faul et al., 2009). I used a medium effect size not only to be lenient, but also to maintain strictness at the same time in the analysis. Cohen (1992) proposed a medium effect size because the value may be able to approximate the average size of observed effects in various fields. Three different sample size computations were conducted because this study involves using three statistical analyses namely paired samples t test, repeated-measures ANOVA, and multiple linear regression. Results of the three sample size computations should be considered and the sample size requirements of all statistical analyses should be satisfied.

First, for the two-tailed, paired samples *t* test with a conventional power of 0.8, a medium effect size of 0.50, and a level of significance of .05, the sample size required was $n = 34$ (see Appendix B). Second, for the repeated measures ANOVA within factors with a conventional power of 0.8, a medium effect size of 0.25, a level of significance of .05, number of groups of 21 hospitals, and number of measurements of 3 (baseline season 2010/2011; 2011/2012; and 2015/2016), the sample size required was $n = 42$ (see Appendix C). Third, for the multiple linear regression analysis with two predictors considering a two-tailed test with a conventional power of 0.8, a medium effect size of 0.15, and level of significance of .05, the sample size required was $n = 55$ (see Appendix D).

The suggested highest number in the three sample size computations used for minimum sample size for this study was 55. However, based on limitations of time constraints, I decided to collect data from at least 21 samples who met the inclusion criteria in order to meet the minimum sample size calculated by the G*Power analysis to have adequate power for determining differences that may exist in the data. This sample size is large enough to provide repeated measure data for ANOVA.

Definitions

Case-Mix Index (CMI): The financial value assigned to each patient based on the Medicare Severity-Diagnosis Related Groups (DRG). A hospital CMI represents the average DRG relative weight for that hospital. It is the total of DRG weight for all Medicare discharges and dividing by the number of discharges (CMS, 2017).

Health care personnel (HCP): All medical and nonmedical employees with direct contact with patients or providing any level of patient care or administration. The entire population of health care workers in any health care settings, which might include both clinical and non-clinical employees, volunteers, and contractors regardless of clinical responsibility or patient contact (CDC, 2017).

Mandatory Healthcare Personnel Safety Reporting Plan: The required reporting for hospital health care facilities receiving patients from the Center of Medicare and Medicaid to report vaccination rate to the NHSN (CDC, 2017).

National Healthcare Safety Network (NHSN): A reporting system for health care organizations functioning under the CDC (CDC, 2017).

Vaccination compliance rate: The total number of HCP who received influenza vaccination at this health care facility relative to the total number of HCP who provided a written report or documentation of influenza vaccination outside this health care facility divided by the total number of HCP who were working at the health care facility between October 1 and March 31 (CDC, 2017).

Vaccination rate: The total number of vaccinated HCP/the total number of HCP presented as a percentage of vaccination.

Healthcare personnel influenza vaccination measure: The reported influenza vaccination measure starts October 1 through March 31 (CDC, 2017)

Vaccination seasonal influenza vaccine: Vaccination definition in this study means the seasonal influenza vaccination. A vaccine for seasonal influenza virus offered on an annual basis (CDC, 2017).

Assumptions

This study assumed that longitudinal data regarding vaccination rates for each AH network hospital over each the eight-years of the entire study period would be available through the State Department of Health, that missing data would be minimum, and that vaccination rates would be accurately and consistently reported over time. It was also assumed that participants would answer the survey questions in an honest and informed manner. Finally, it was assumed that respondents shared a sincere interest in participating in the research and did not have any other motives for participating.

In this research, I assumed that all hospitals within the AH network followed the mandatory reporting requirement and frequently reported HCP influenza vaccination rate on annual base (CDC, 2017). Furthermore, I assumed that CDC definitions related to the mandatory reporting were followed and data collected accordingly by each facility within the network. These assumptions were essential to the study validity since the specifications of the reporting structure by CDC is well demonstrated through reporting criteria and facilities are familiar with the reporting system through reporting other measures such as central line associated blood stream infections (CDC, 2017).

Scope and Delimitations

This quantitative study represents an inquiry on the impact of mandatory reporting on the influenza vaccination rate among HCP. The study boundaries were: (a) all hospitals included in the AH network, (b) available influenza rates before and after mandatory reporting, and (c) strategies used by each facility to improve vaccination uptake.

Limitations of the study could stream from data availability, inconsistent strategies outlined or knowledge about historical strategies used over the years due to information recall. Additionally, facilities within the network have joined network at different times within the study timeline, which means the organization specific strategy might not apply to these specific facilities.

Data collected for this study represented only hospitals within the AH network and may not apply to other networks. The cohort of hospitals used in the study within the network may not accurately represent all United States hospitals. This delimitation may have decreased the ability to generalize the findings of the study. Since the questionnaire provided to the hospitals included their rate compared to their peers within the same health care networks, the hospital administrators answering the questionnaire may not have the awareness of historical influenza vaccination activities to respond to the questionnaire adequately.

Limitations

A primary limitation of longitudinal data analysis can be missing values. Occasional omissions of data are a common risk in data dependent on repeated measures (Yang & Shoptaw, 2005). Only hospitals with complete data for premandatory reporting seasons (2010/2011 to 2013/2014) and postmandatory reporting seasons (201/2015 to 2017/2018) were included in the study. Thus, the data collected may not be a comprehensive representation of the entire AH Network.

Furthermore, the findings related to the AH network may not be generalizable to another health care network due to geographic locations, system strategies, priority variation, and county mandates. The data collection survey was not based on a validated scale, but the questions were crafted to be as straightforward as possible to permit objective responses. While the hospitals within this specific health care network differed in bed size and services provided, they were likely to be homogenous as they belonged to the same network. There may be unknown conditions or factors at the medical facilities where the participants were employed. Finally, a low number of participants might not be adequate to draw conclusions from survey responses.

Significance

There are multiple studies related to HCP vaccination rate; however, most of the studies focus on the knowledge, perceived risk of vaccination, and vaccination uptake. Healthy People 2020 announced an influenza vaccination intake goal of 90% for HCP by the year 2020. The CDC has been attempting to track the compliance or the intake of the vaccination among HCP over the past eight years. However, the impact of mandatory reporting on vaccine uptake among HCP has not been widely studied. This study was among the earliest studies to close the gap in knowledge regarding the relationship between a reporting mandate and actual vaccination rates.

Influenza imposes a significant burden worldwide from both health care and socioeconomic standpoints. HCP are at increased risk of exposure to respiratory pathogens like influenza compared with the general population, which is a potential threat for their health and for patients' safety. The main determinants of vaccine acceptance among HCP have been most closely associated with self-protection and protection of the health workers family, rather than the protection of patients.

HCP have the ethical and professional responsibility to reduce any risk of infection transmitted to their patients. Health care networks are also obligated to protect their staff from harm through prevention. However, influenza vaccine hesitancy among HCP is associated with low-risk perception, low pressure, negative attitudes toward vaccines, and lack of adequate influenza-specific knowledge.

While immunization is believed to be the fundamental tool for prevention, vaccination among health care workers involves a host of social, behavioral, informational, and ethical issues. Hence, positive social change leading to a reduction of the health and economic burden of influenza-related outbreaks relies on understanding multiple issues. Mandatory immunization reporting policies are currently under debate, both nationally and internationally (Rosenbaum, 2012). This study seeks to more clearly understand the impact of legislation and organizational strategies related to vaccine uptake. Results of this study can provide data for policymakers and stakeholders to shape evidence-based initiatives and programs for improving vaccination uptake and influenza control within the AH network or other health care networks.

Summary

Many researchers have examined different vaccination behaviors among HCP. However, a research gap exists in examining the trends in vaccination rates relative to mandatory reporting policies. Results from this study provide the first examination of influenza vaccination trends among AH network employees since the health care employee vaccinations were mandated in 2012. Paired samples *t* test, repeated measures ANOVA, and multiple linear regressions analysis of quantitative data were performed to provide additional knowledge of the relationship between HCP influenza vaccination rates, legislation, beliefs, practices, and suggestions useful for maximizing the vaccination rates within this health care network.

This chapter provided an overview of the objectives of the study with essential background information about influenza vaccination among health care workers. It also outlined the gap in empirical research and the benefits of closing the knowledge gap associated with HCP influenza vaccination and mandatory reporting.

A literature review will be provided in Chapter 2. The literature covers topics including: (a) the history of influenza virus including the biological structure of the virus, transmission and prevention, and vaccination and recommendation history (b) theoretical foundation related to vaccination efforts and nosocomial transmission (c) health care personnel attitude toward vaccination (d) efficacy and effectiveness of vaccination (e) background review on the application of PMT and (f) social and economic impact of influenza. The study design, method, sampling, variables assessment, data collection, and analysis of variables will be covered in Chapter 3.

Chapter 2: Literature Review

Introduction

Influenza is an infectious virus that can cause severe health complications and sometimes death, especially among vulnerable populations like those with chronic diseases, obesity, smoking, renal disease, diabetes mellitus and immunosuppression, and those who delay seeking medical attention or treatment (National Vaccine Advisory Committee, 2013). Health care personnel (HCP) including physicians, nurses, midlevel providers, and allied health professionals are in frequent contact with ill individuals who are most susceptible to influenza and hence HCP are among the most likely sources of virus transmission to other persons, especially those who are vulnerable to the disease.

The mode of transmission for the influenza virus is droplets from sneezing, coughing, or touching contaminated surfaces (CDC, 2013c). Hand hygiene, social distance, and mouth covering during a cough, influenza vaccination are primary prevention strategies against the transmission of the influenza virus (CDC, 2013c). HCP should be informed of preventable diseases by vaccination strategies and should have access to free vaccination programs at their place of employment (CDC, 2013c). The uptake of influenza vaccination among HCP has been a goal under Healthy People 2020 initiatives (National Vaccine Advisory Committee, 2013). The overall goal is to reach a 90% vaccination rate among HCP by the year 2020 (National Vaccine Advisory Committee, 2013).

As addressed in Chapter 1, public health policies have been implemented to require mandatory reporting of vaccination rates of HCP in health care facilities to ensure the goal of Healthy People 2020 is met. Therefore, the purpose of this quantitative study was to explore and measure the effectiveness of these policies on mandatory reporting and their relationship to vaccine intake among HCP.

This chapter includes the literature search strategy, the theoretical foundation related to this study, and existing literature related to influenza vaccination. The literature search strategy section summarizes how relevant studies were chosen. The section on existing literature about influenza vaccination includes discussion of the influenza virus, the history of the vaccine, vaccine implementation strategies, and attitudes among HCP and policymakers about vaccination. Finally, the chapter covers the ethical dilemmas surrounding influenza vaccination among HCP.

Literature Search Strategy

Multiple databases, including the Nursing and Allied Health Literature (CINAHL), MEDLINE, and the Cochrane Database of Systematic Literature, were utilized to perform literature searches for this study. Key search terms were “influenza,” “mandatory,” “healthcare personnel,” “health belief model,” “socio-economic status,” “knowledge and attitude,” “outbreak,” “nosocomial cases,” and “vaccination,” along with combinations of these search terms. Research papers reviewed were limited to full-text articles published from 2000 to 2017 in peer-reviewed journals.

Additional resources came from databases and publications managed and released by CDC and related organizations. Guidelines on influenza vaccination came from the Agency’s Advisory Committee on Immunization Practices (ACIP) and the National Vaccine Advisory Committee. Other data on influenza vaccination came from the

Strategic Advisory Group of Experts on Immunization from WHO.; Finally, the Joint Commission (TJC) provided their requirements for HCP vaccination for accreditation of health care facilities.

Theoretical Foundation

Conceptual Framework

Several theories, including the HBM, TRA, and SEU, could have been used for this study because of their value in applying potential motivation towards health protection (Floyd et al., 2000). It was determined, however, that PMT (see Stroebe, 2011) was most optimal for framing the study.

The PMT was initially developed by Rogers (1975) to examine the prediction of smoking, traffic safety, and venereal disease. The PMT was revised between 1983 and 1987 to include protection motivation (Stroebe, 2011). This theory has been used to explain health decisions and actions individuals take to protect themselves from a threat . The theory has been applied beyond health care in areas such as information system security procedures (Vance et al., 2012). It has also been applied to health-related issues such as injury prevention, political issues, protecting others, and environmental concerns (Floyd et al., 2000).

The protection motivation concept applies to any health threat that impacting for individuals or organizations' health recommendations. There are three main stages for PMT. The first stage involves considering the sources of information required for assessing the health threat. The second stage is cognitive mediating processes that apply coping appraisal to the threat or fear. Finally, the last step involves modes of coping toward the protection motivation, which can be defined as adaptive or maladaptive (Floyd et al., 2000).

Health care facilities may be motivated by public health responsibility, namely reaching the Healthy Persons 2020 90% vaccination rate target. Mandatory reporting and tracking of vaccination rates may be established by facilities to avoid potential quality performance financial penalties when goals are not met. HCP are motivated to seek vaccination by different environmental, observational learning, intrapersonal variables, and prior personal experiences that surround the influenza vaccination (e.g., desire for protection from influenza, fear of side effects, doubts about vaccine efficacy (Chor et al., 2009).

Literature Review Related to Key Variables and Concepts

The Influenza Virus

The "Spanish Flu" is the first influenza pandemic recorded. It occurred in 1918-1919 and was responsible for approximately 546,000 deaths. However, the influenza virus was not isolated until the 1930s. In 1995, archeological material from 1918 autopsies identified a ribonucleic acid (RNA) from a small fragment of the viral linking the Spanish Flu of 1918 to the contemporary influenza virus (Taubenberger & Morens, 2010). In 1941, the United States entered World War II, during which time the influenza pandemic reemerged. History suggests that war and disease have been linked for centuries and that wars magnify the spread and severity of disease by disrupting populations (Dowdle, 2006).

According to Dowdle (2006), prior to World War II, soldiers died more often of disease than of battle injuries. The influenza pandemic accounted for roughly half of U.S. military casualties in Europe during World War II. The U.S. military recognized that infectious disease was as dangerous an enemy as any other they would meet on the battlefield. The devastating toll of influenza on U.S. military generated one of the first partnerships to link the military, industry, academia, and the government to develop vaccines. It also inspired the formation of the Commission on Influenza.

The main priority of the Commission on Influenza was to develop influenza vaccination (Dowdle, 2006). The first vaccination trials were in 1943. However, subsequent vaccination trials in 1947 failed as an effective prophylactic for influenza A antigenic variant. However, the antigenic shift was discovered as a characteristic of the virus. The Commission on Influenza also identified the basis of the hemagglutination inhibition (HI) as a subgroup of influenza A.

Dowdle (2006) also reported that in 1957, the Asian virus pandemic, which appeared exactly 10 years from the influenza A virus of 1947, increased knowledge on the virus predictability. During the same time, HI antibodies of the Asian virus strains were found in persons older than 75 years of age, suggesting the recycling of the human influenza viruses (Cox & Subbarao, 2000; Dowdle, 2006). Eleven years after the Asian virus pandemic, the 1968 A2/Hong Kong virus provided further evidence of the antigenic shift of the influenza virus (Russell & Webster, 2005). Same as the Asian virus, the HI antibodies were found among persons over 85 years of age, suggesting that the virus had previously appeared among the same human population (Dowdle, 2006). Dowdle also noted that in 1977, the swine influenza in the United States was proven to transmit person-to-person, causing multiple mild symptoms. Not yet pandemic, the 1977 epidemic provided more insight to the antigenic shift .

According to Dowdle (2006), a clearer understanding of changes in earlier influenza strains from Hsw1 to H1N1 is warranted. The scientific study of influenza virus evolution has led to the belief that the pandemics in 1918, 1957, and1968 may have involved over 2,000 different strains. Multiple viral strains have forced public health professionals to be prepared through pandemic emergency preparedness, planning, and readiness.

Biology of Influenza

The influenza virus is categorized under three genera - A, B, and C. Pandemics causing influenza in human are influenza A and B. Each subtype is based on two surface antigens: hemagglutinin (HA) and neuraminidase (NA). The two surface antigens are found to be associated with the pathogenicity of the influenza A virus due to the variation of 16 HA and nine NA causing the change in immunity against the virus. Since 1977, Influenza A (H1N1) and influenza B (H3N2) viruses have been the dominant strains circulating. Influenza viruses belong to the Orthomyxoviridae family and have a length of 200 to 300 nanometers and a diameter range from 80 to 120 nanometers (Bouvier & Palese, 2008). Influenza B viruses are known to cause less severe illness and are not associated with any pandemics. However, the genome structure for influenza A and B are similar in that each contains eight negative-sense and single-stranded viral RNA (vRNA) segments. By comparison, influenza C viruses contain a seven-segment genome.

The Influenza B virus is constructed around a homogenous group and was identified in the 1970s for its distinct lineages for two main antigenic (Biere et al., 2010). The lineages were identified as B/Victoria/2/87 and B/Yamagata/16/88. Viruses resulting in those two lineages have appeared at different times and in different geographical distribution (Hay et al., 2001).

The cocirculation characterization of the influenza B viruses puzzled the world with regard to influenza vaccination recommendations (Hay et al., 2001). In 1998, the WHO recommended coverage of different vaccination of the influenza B virus based on the prevalence of the historical lineages present in the geographic distribution of the virus. As of 2001, there had been no changes in the persistence of the two lineages in influenza B type for over 25 years (Cunha, 2004).

The influenza virus is identified as a negative-strand RNA genome that depends on RNA polymerase for replication. The virus gains host attachment properties because of its ability to recognize the N-acetylneuraminic (sialic) acid on the cell surface of the host (Bouvier & Palese, 2008). The virus then attaches itself to the tracheal epithelial cell of the host through the sialic acids' linkages existing in the human respiratory epithelium.

The 1918 pandemic historical review added to the evolving knowledge about the influenza virus. In the 1930s, the cause of human influenza virus was linked to the avian and swine influenza (Taubenberger & Morens, 2010). The unique attachment characteristics of the avian influenza virus allow to gain the ability to infect humans and other primates (Bouvier & Palese, 2008). Once an avian strain causes the infection, the pathogenicity occurrence is high. The avian strain can rapidly reproduce within the lung, while other strains mainly suspend at the upper respiratory. The replication process that occurs once an avian strain of the virus enters the human body could further explain the antigenic drift.

The replication process depends on the virus genome and proteins that cause both antigenic drift and antigenic shift (Bouvier & Palese, 2008). Antigenic drift caused by mutation during the replication process results in a new strain of the virus without any ability to cause recognition by the body. The antigenic shift caused by changes in at least two viral genomes results in a new subtype of virus lacking immunity. Antigenic changes in the virus are among the reasons for the inability to immunize against all subtypes in a one-time vaccination. Hence, vaccination depends on the predicted prevalence of influenza subtypes each season.

Transmission of Influenza

The mode of transmission of the influenza virus has been recently challenged. In a study conducted with systematic review of information on the inactivation of the influenza virus in the environment, Weber and Stilianakis (2008) examined the relative importance of airborne, droplet, and contact. The daily inactivation rates were examined on inanimate surfaces and in aerosols. They were found to be measured at a lower rate than an infectious nasal dose of the influenza virus. Inhaling the virus through direct droplet transmission causes a higher viral load to enter the respiratory airway faster and more aggressively. Once the virus aerosolizes in the air or lands on the inanimate surface, even low doses can cause direct nasal infections.

Virus Pathogenicity

Once the virus infects the epithelium lining of the respiratory tract, the infection may occur in the upper and lower airways (Maltezou & Tsakris, 2011). The incubation of the virus may range from one to four days but it can potentially multiply within two days. As many as half of all humans infected with the influenza virus are asymptomatic and may not realize they are infected. However, asymptomatic infected individuals continue to shed the virus and may still transmit the virus to others. Viral shedding can begin the day before symptoms appear and can continue for three to five days after becoming symptomatic.

Children can shed the virus for up to three weeks, while immune-compromised individuals can continue to shed the virus for an even longer period. Ng et al. (2017) estimated that 69% of children under five years of age, 67% of children aged 6 to 15 years, and 45% of adults over 16 years of age, showed presymptomatic viral shedding. While no significant differences in viral strains or subtypes were found between age groups, it was found that adults started shedding the influenza virus 53% (approximately two days) later than young children. Coughing and sneezing are the common symptoms of influenza infection that cause the production of droplets and facilitating droplet nuclei transmission. The ability to infect individuals, causing a range of symptoms, depends on the lack of antibody titers and exposure to a strain with a higher viral load.

Nosocomial Influenza Transmission

Promoting awareness for influenza vaccination among HCP continues to grow. Organizations, agencies, state and municipal governments across the United States have joined forces to create legislative and regulatory mandates to enhance vaccination rates among HCP (Tilburt et al.,2008). Influenza can be transmitted regardless of whether the infected individual is symptomatic or asymptomatic. The majority of infected HCP are likely to work during their illness and hence, increase the risk of transmission to patients and coworkers within the health care network. Between 3-50% of patients and 11-59% of coworkers are exposed to the virus each year.

The infection and mortality rates experienced among hospitalized patients vary by the type of health care setting and the health condition of the exposed patients. Nosocomial influenza most commonly occurs among immune-compromised patients, newborns in neonatal intensive care units (NICU), bone marrow transplant recipients, and elderly patients with obstructive pulmonary disease (Maltezou & Tsakris, 2011). Mortality rates as high as 60% have been noted among those infected while in a transplant setting. Additional considerations include early detection of admitted cases and the practice of precaution such as wearing masks and eye protection while providing direct care to patients. Nosocomial influenza costs the health care system an estimated $7,545 per case for an average of eight days of inpatient care. A survey aimed to assess the impact of influenza on health care institutions in the United States, found a shortage for hospital beds (28%), staff (35%), and ICU beds (43%) during the peak of the influenza season.

A pandemic simulation model demonstrates that the attack rate among unvaccinated HCP is 60% higher than non-HCP adults. However, because influenza varies between mild to severe, it is difficult to estimate its real impact (Maltezou &

Tsakris, 2011). Influenza outbreaks can go undetected and undocumented because the symptoms are mild. During outbreaks, the public health burden to control and limit transmission has impacted access to preventative measures. The most critical lesson was to learn how preventable influenza virus outbreaks could be better detected. Lessons learned during the outbreak investigations have also improved education on the respiratory etiquette, especially in settings where influenza can spread rapidly (CDC, 2012).

In a case-control study, researchers examined the impact on Hospital-Acquired Influenza (HAI) influenza vaccination rates for HCP. The study investigated the influenza-like illness (ILI) in an acute university hospital through the implementation of prospective surveillance (Bénet et al., 2012). Patients with HAI were identified by a confirmed influenza virology test that occurred more than 72 hours after admission. A negative nasal swab testing for those presented with ILI during hospitalization identified the controls. A total of 55 patients were analyzed; 11 patients had a lab-confirmed HAI. The median HCP vaccination rate was 36% however, in units where HAI cases were found, the median HCP vaccination rate was 11.5%. The authors of the study concluded that units with higher than 35% HCP vaccination rates were less likely to have HAI patients. The significance of this study supports the association of HCP vaccination rates and nosocomial influenza.

During an influenza outbreak, health care organizations treat staff and residents with both chemoprophylaxis and vaccinations. In a systematic review of the effectiveness of control measures, long-term care facilities reported control measures reported for 60 influenza outbreaks (Rainwater-Lovett et al., 2014). The study found that prophylaxis treatment and other non-pharmaceutical approaches considerably lowered attack rates among staff and residents. It was concluded that controlling outbreaks resulted in a considerable reduction in the financial burden of health care facilities (Rainwater-Lovett et al., 2014).

An international study was conducted to examine vaccination coverage among patients and staff (Music, 2012). The study conducted by the International Federation of Pharmaceutical Manufacturers and Association (IFPMA), aimed to examine immunization recommendations and HCP vaccination rates for 26 countries worldwide (Music, 2012). While WHO recommendation on HCP immunization is widely known, the authors found that 88% of countries have their own suggestions to support the vaccination of HCP. It was found that approximately 60% of the countries financially support influenza education, assure free access to vaccines, and track declined vaccination by HCP (Music, 2012).

Music (2012) recommended more education about vaccine safety and efficacy and influenza risk as part of the effort to improve overall coverage. The impact of vaccination shortage and lack of access on vaccination uptake was also acknowledged. Many countries are aggressively tackling barriers, enforcing policies, and practicing other methods to further accelerate vaccination uptake and other obligatory hygiene measures (Music, 2012).

Influenza Distribution

The distribution of influenza activity varies by the virulence of the virus and herd immunity. A report released by the CDC on the virus distribution of influenza during the 2012-2013 season found that infection peaked between November and late December (CDC, 2013c). The influenza A (H3N2) virus was the predominant strain, followed by the 2009 influenza A (H1N1). The 2012-2013 season had higher influenza-induced hospitalization, morbidity, and mortality rates when compared to recent years (CDC, 2013c).

The total number of respiratory specimens tested for influenza was 368,531 yielding to 75,342 positive results of influenza virus (CDC, 2013c). The distribution of the strains from the positive tests was 70% influenza A virus and 30% influenza B virus (CDC, 2013c). The Influenza A virus was sub-typed as H3N2 (94%) and H1N1 (6%). Less than 1% of the influenza A virus was associated with variant H1N1v or H3N2v strains. Influenza B was 63.8% B/Yamagata and 36.2% B/Victoria lineages of the virus (CDC, 2013c).

While the majority of circulating influenza viruses were susceptible to the antiviral treatment, substantial, persistent resistance to the treatments of oseltamivir and zanamivir was noted for the H1N1 and H3N2 viral strains. Between 5.5% and 9.9% of influenza-related deaths were attributed to pneumonia (CDC, 2013c).

Of the cases studied, 169 ne deaths were laboratory-confirmed as influenza-related. The average age of children dying from influenza-related disease was 7.8 years. Over a third (34%) of reported child deaths were among children under five years of age

(CDC, 2013c). The overall hospitalization rates per 100,000 populations during the same season were reported as 44.4 per 100,000 children 0-4 years of age, 14.5 per 100,000 children 5-17 years, 16.2 per 100,000 adults 18-49 years, 41.3 per 100,000 adults 50-64 years, and 192.4 per 100,000 adults over 65 years of age. Increases in hospitalization rates have been most pronounced among the elderly (CDC, 2013c).

The surveillance of seasonal influenza provides more reasons for focusing on vaccination efforts to prevent influenza virus among children and elderly (CDC, 2013c). The surveillance provided the influenza distribution in numbers that put the seasonal influenza problem in perspective because it provides an estimation of the influenza burden in the community and across the nation. Influenza causes a burden every year due to hospitalization, mortality, loss of income, and other financial hardship (CDC, 2013c).

Economic Impact of Influenza Virus

Molinari et al. (2007) conducted a study using a probabilistic model of influenza-attributed cases, hospitalizations, estimated health insurance claims, and projected loss in earnings. The burden of seasonal influenza epidemics was estimated to be more than $16.3 billion in lost wages, $10.4 billion in direct costs (hospitalization and outpatient visits), and approximately $87.1 billion in costs due to loss of life (Molinari et al., 2007). The authors of this study argued that a vaccine to prevent disease such as influenza has a tremendous impact on economics (Molinari et al., 2007).

Influenza Vaccination Recommendations

The World Health Organization

The WHO provides information on the status of influenza and recommendations on prevention efforts at the global level (WHO, 2013). The Strategic Advisory Group of Experts on Immunization (SAGE) recommended that an influenza vaccination should be provided for HCP working with high-risk groups inclusive of children under five years of age and the elderly. This recommendation prioritizes vaccinations for HCP working with high-risk groups in case of vaccination shortage (WHO, 2013).

Vaccination programs target these high-risk groups as well as pregnant women. The WHO recommendations on influenza vaccination are very extensive. However, the SAGE committee requires countries to assess their vaccination programs and determine the burden of disease, feasibility of vaccination, and cost-effectiveness of prioritizing influenza vaccinations (WHO, 2013).

The Society for Healthcare Epidemiology of America (SHEA)

SHEA is a reputable source for reporting health care epidemiology. In a recent publication, SHEA released a position statement that supported the use of the influenza vaccination as an essential patient and HCP safety and infection prevention practice. The non-compliance with annual influenza vaccination is seen as ethical and professional recklessness from HCP and health care institutions. Also, a SHEA position statement endorsed the influenza annual vaccination requirement as a condition for initial and continued HCP employment within health care institutions. The recommendation from

SHEA included policy and program implementation for full influenza vaccination and prevention programs (Talbot et al., 2010).

Organizational support is essential to enforce SHEA's recommendation that HCP vaccinations be a condition of employment (Talbot et al., 2010). Leadership support allows for clear communication within the organization. Resource allocation was an essential element of the SHEA position paper because it allows for proper implementation and sustainability of HCP influenza vaccination programs. The recommendation included all HCP who provide direct patient care as either a contractor or employee of an institution and extends to all volunteers, contracted workers, and students. Medical contraindications were the only exceptions to HCP influenza vaccination acceptable by SHEA. Recommendations were particularly relevant for institutions seeking accreditation and licensing and provide a sense of accountability to ensure the safety of staff and patients (Talbot et al., 2010).

Advisory Committee on Immunization Practices (ACIP)

ACIP is a subcommittee of the CDC comprised of medical professionals who examine immunization practices and issues recommendations based on supporting evidence. Their latest recommendations for prevention and control of influenza through vaccination were updated in 2013. Health care workers now include all health care professionals, trainees, volunteers, and caregivers for persons at high risk for influenza-related complications (CDC, 2013a). ACIP recommendations also added special requirements to include not only inpatient settings but also outpatient settings such as medical emergency response workers (paramedics and emergency medical technicians), nursing home, and long-term care personnel (CDC, 2013a).

The type of vaccination indicated in the ACIP recommendations includes the consideration of avoiding live attenuated influenza vaccines (LAIV) because of the theoretical risk of transmitting the live influenza vaccine virus to immune-compromised individuals (CDC, 2013a). HCP and caregivers who receive LAIV were recommended to avoid contact with immune-suppressed persons for seven days after vaccination to ensure there is no risk of transmitting the influenza virus (CDC, 2013a).

The seasonal influenza vaccine was recommended to be administered in settings where a rapid recognition of allergic reaction to the vaccine and anaphylaxis treatment was available and could be rapidly administered (CDC, 2013a). The ACIP recommendation covered concerns associated with allergy, immune-compromised contact, and dosage recommendations that left no reasons for HCP to avoid vaccination (CDC, 2013a). In the cases of persons with egg allergies, an egg-free recombinant influenza vaccine RIV3 was recommended (CDC, 2013a).

National Vaccine Advisory Committee

The U.S. Department of Health and Human Services (HHS), the CDC, and other public health agencies recommended the influenza vaccination for HCP. Despite their recommendations, the HCP influenza vaccination rates remained inadequate while nosocomial transmission continued to increase (National Vaccine Advisory Committee [NVAC], 2013). The HHS assistant secretary for health directed the NVAC toward the development of strategies toward achieving the Healthy People goal of 90% coverage of health care workers by the year 2020 (NVAC, 2013). NVAC set different recommendations in a tied set of strategies aimed to outline the methodology of achieving the HP 2020 annual goal. The recommendations also covered the implementation and managing of the influenza prevention programs and measuring the vaccination coverage through mandatory reporting (NVAC, 2013).

The NVAC recommended that all hospitals and health care facilities integrate the influenza vaccination program as part of their infection prevention or occupational health program (NVAC, 2013). The HHS would hold requirements for implementing an influenza program for staff of facilities and services provided by HHS and federally qualified health centers (NVAC, 2013). The CMS and CDC were required to continue the standardization process for the method used to measure compliance with HCP influenza vaccination rates within different health care settings (NVAC, 2013).

More importantly, the adoption of the recommendation was required for CMS-regulated or licensed facilities as an enforcement mechanism (NVAC, 2013). The recommendation also included mandatory vaccination rate reporting to track the vaccination intake among HCP. The reporting requirements began with acute care facilities and extended to include other health care facilities, such as long-term care and skilled nursing facilities (NVAC, 2013). The Hospital Inpatient Quality reporting utilizes the CDC's National Healthcare Safety Network (NHSN) which is the nation's most widely used health care-associated infection tracking system and allows patients to compare hospital quality indicators (NVAC, 2013).

The NVAC provides the most comprehensive recommendations related to improving the HCP vaccination rate (NVAC, 2013). The recommendations provide step-by-step guidance on starting an influenza vaccination program. The lack of data on barriers for HP 2010 was noted (Koh, 2010). The recommendation supported not only education on vaccination, but the ability for staff to provide feedback on vaccination intake barriers (NVAC, 2013). The reporting mechanism ensures the ability to track the influenza vaccination rate, according to HP 2020. Hospitals that fail to meet the targeted performance measures, including proposed HCP influenza vaccination rates, are subject to a 2% payment reduction from the CMS.

Association for Profession in Infection Control and Epidemiology (APIC)

The Association for Profession in Infection Control and Epidemiology (APIC) is a leading professional association for infection prevention for more than 15,000 members. APIC's mission is to prevent infection for a safer world. Infection prevention practices in health care aim to provide a higher quality of health care at a lower cost by preventing health care-associated infections. Approximately 31 million outpatient visits, 150,000 hospitalizations, and 24,000 deaths associated with influenza were estimated to occur annually. In response to the morbidity and mortality associated with complications associated with influenza, the APIC issued a position paper in 2011 proposing that influenza vaccination become a condition of employment for HCP.

The APIC position paper included the recommendation that acute care hospitals, long term care, and other facilities be included in vaccination requirements as a condition of employment. Evidence demonstrated that organizations that made vaccinations mandatory as a condition of employment were significantly more likely to meet the 90% goal. The immunization requirement for employment demonstrated that health care organizations were responsible for incorporating recommendations into human resource policies. Other workplace strategies included infection prevention practices such as hand hygiene, respiratory etiquette, and wearing a surgical mask by nonvaccinated HCP for the duration of the influenza season.

The position paper also provided compelling evidence that influenza vaccination is particularly useful for averting infection among young and healthy individuals. Patients are more susceptible to acquire influenza due to age or reduced immunity, so they develop a lesser response to the vaccination. Hence, vaccinating individuals who are exposed to susceptible populations is the most effective prevention strategy. The rationale for writing the position paper was enforced by evidence-based studies that have found that over 70% of HCP continues to work while infected with the influenza virus. This behavior exposes both coworkers and patients alike to viral infection (Green et al., 2011)

TJC Standards

TJC is an accreditation body which holds health care organizations to high standards as a condition of accreditation (Lugo, 2007). Lugo reported that in 2006, TJC produced a standard that requires accredited health care organizations to implement an influenza vaccination program for staff through multifaceted immunization programming or as a condition of employment. The new standard also required employee immunization rates to be tracked for improvement.

TJC standards requiring influenza vaccination added a powerful statement that required organizations to enforce immunization among staff (Lugo, 2007). Vaccination uptake for HCP required policy changes at the organizational, local, state, and federal levels. Mandated vaccination reporting was generally perceived as non-effective for organizations that did not require vaccinations as a condition of employment.

In 2012, TJC issued additional vaccination requirements for accredited organizations and TJC-licensed independent practitioners (Joint Commission, 2012). This requirement was attached to the standard of infection control, where vaccination for licensed independent practitioners and staff were in effect for all accredited programs. The requirement extends to ambulatory care, behavioral health care, laboratory, office-based surgery, home care, and all CMS based long term care programs seeking accreditation. Adherence to influenza vaccination by health care staff was part of the "elements of performance" and proved that the organization was actively trying to meet standards as a condition of accreditation.

Some of the elements of performance for this standard require organizations to offer a vaccination program to all staff as well as licensed independent practitioners (Joint Commission, 2012, 2012). The education requirement for independent practitioners is meant to ensure that information on the impact, transmission, and prevention of influenza was communicated. Additional elements of performance include providing free and accessible vaccination on site and provide HCP the time to receive the vaccination.

Accredited organizations will need to include a written infection control plan where the goals for achieving the 90% compliance of HP 2020 and HHS are outlined

(Joint Commission , 2012). The declination for vaccination is required, rarely exempted, evaluated, and reported to stakeholders and employees on an annual basis. The rationale for TJC influenza vaccination standards lies in evidence that demonstrates that lack of immunization for health care workers carries safety consequences to susceptible patients.

HCP Influenza Vaccination Rate Improvement Strategies

After four decades of eradicating several infectious diseases through antibiotic treatments and vaccine prevention, the influenza virus has remained the most common vaccine-preventable disease in the developed world (Maltezou & Tsakris, 2011). The ACIP issued several recommendations, including educating HCP about the virus and requiring health care institutions to provide staff with influenza vaccinations free of charge (Maltezou & Tsakris, 2011; NVAC, 2013). These recommendations started in 1984 without making any progress toward improving HCP vaccination rates during the decades to follow. In spite of documented evidence that the influenza vaccine reduces illness and absenteeism, the vaccination rate for HCP never exceeded 50% before the mandate was introduced in 2012 (Maltezou & Tsakris, 2011).

Historically, the protection of health care workers, and not the patients, was not the main reason for influenza vaccination by HCP. However, after realizing the benefits of protecting staff and patients, many health care institutions made vaccination mandatory as a condition of employment (Maltezou & Tsakris, 2011; NVAC, 2013). The Association for Professional in Infection Control and Epidemiology (APIC) along with the National Foundation for Infectious Diseases (NFID) and the National Patient Safety Foundation (NPSF) have endorsed HCP influenza vaccination and encouraged hospitals to achieve more than 95% coverage for their staff (Maltezou & Tsakris, 2011; NVAC, 2013).

According to Maltezou and Tsakaris (2011) and NVAC (2013), different organizations have been able to achieve reliable results by implementing campaigns inclusive of educating staff of the benefits, safety, and efficacy of the influenza vaccination. Using senior medical staff respected by staff members as a role model is another strategy used to promote immunization among staff. Additional strategies they reported include providing vaccination during different shifts and using mobile carts to increase secure access.

Vaccine Accessibility

Vaccine availability to HCP is one of the strategies to improve the vaccination rate. The more available and convenient vaccination is made for staff, the higher the compliance and intake. Between 2000 and 2002, the use of a mobile cart was examined as a possible strategy to enhance access to the influenza vaccination program (NVAC, 2013; Sartor et al., 2004). The authors estimated the vaccination intake increased from 6% in 1998 to 32% in 2002. While vaccination intake at University Hospital System was found to increase over five-fold in five years, the percentage remained far from the Healthy People 2020 target goal of 90% (NVAC, 2013).

Declination Policy

In a study conducted by the Infectious Diseases Society of America (IDSA), the impact of implementing a declination policy for the influenza vaccination was assessed to examine the resistance by HCP to receive the annual influenza vaccination (Polgreen et al., 2008). Respondents were asked to report their HCP vaccination rate before and after the implementation of the declination policy that requires HCP to provide a signed statement declaring the intention to decline the influenza vaccination. Only 22% of the 100 organizations studied were able to provide the vaccination rate before and after the implementation of declination policy. Among those who did offer pre-and post-mandate rates, a 28% increase ($p < .001$) in the HCP vaccination rate was noted after the implementation of the declination. The average immunization rate increased from 50% to 64% after the declination policy was implemented. Changes were more pronounced among institutions that initially reported lower vaccination rates.

An additional finding of Polgreen et al. (2008) suggested that the mandatory declination program produced a significant increase in immunization rates among 13 institutions because the HCP feared certain consequences. A declination statement alone was recognized by the study as an inadequate initiative. Other initiatives they found were associated with increased vaccination rate included an education measure along with the use of declination statement or mandate for an employer to offer vaccination..

Lack of administrative support to fully adopt the declination policy was considered among the several limitations of the study by Polgreen et al. (2008). Despite those limitations, they were able to demonstrate that the declination policy was a beneficial strategy for increasing HCP vaccination rates. They suggested that it could be modified and used by other institutions.

Mandatory Vaccination Policy to Practice

One of the recommended strategies to improve HCP vaccination rates is the implementation of mandatory influenza vaccination as a condition of employment. In a study of a large health care network with more than 26,000 employees, the vaccination rate among staff was below target (Babcock et al., 2010). In 2008, all HCP were mandated to be vaccinated, or their work with the organization would be terminated. Exceptions were made only for those who met the requirements for medical or religious exemption. Medical exemptions required justification from a licensed physician. Religious exemption applications often required documentation or confirmation from a religious leader. Employees who had been declined medical exemption and later applied for a religious exemption were denied both exemptions. Mandatory vaccination as a condition of employment was responsible for an HCP vaccination rate increase from 32% in 1997 to 71% in 2007.

Babcock et al. (2010) provided an example of a mandatory vaccination requirement as a condition of employment. In their study of 26,000 employees and 900 residents and fellows, compliance with HCP vaccination as part of an employment policy was examined. Among the study participants, 98.4% were vaccinated. Among those not vaccinated, 90 employees or less than .4% were granted a religious exemption, while 321 employees or about 1.2% were granted medical exemptions for allergies to vaccine components, or for having a history of Guillain-Barre Syndrome. The few (N=8) who refused to comply without a legitimate exemption were terminated. Among the noncompliant employees, six provided direct patient care, and two worked in the front office.

Multifaceted Interventions

Honda et al. (2013) aimed to examine a multifaceted approach versus the mandatory requirements for influenza vaccination uptake among staff. In this Japanese tertiary care center, interventions included the use of the declination form, providing free vaccination, communication of vaccination availability through hospital-wide announcements, prospective auditing, and phone interviews with HCP who did not receive a vaccination. The result of this multifaceted approach resulted in an increase of vaccination uptake among HCP reached 97% in the 2012-2013 flu season, thereby substantially exceeding the stated 90% goal..

Vaccinations mandates to assure successful HCP immunization rates have been challenged (Honda et al., 2013). It has been argued that similar improvements can be achieved through comprehensive strategies implemented and supported with strong leadership (Honda et al., 2013). A noted limitation of Honda et al.'s study was that figures for the trended increase as a result of the multiple-approach interventions were not reported.

Thompson et al. (2013) examined the potential barriers to vaccination before implementing mandatory vaccination. In this prospective cohort study 1,670 HCP providing direct patient care were asked their opinions regarding twelve vaccine promotion strategies and their impact on the likelihood of getting vaccinated (Thompson et al., 2013). The internet-based survey was conducted at the post-season. Vaccinated and unvaccinated HCP responses were cross-examined. One in five staff were unvaccinated, half of whom reported that a mandatory vaccination requirement would likely motivate them to be vaccinated. Nearly 62% of all of the respondents identified at least one strategy other than mandatory vaccination that would improve their likelihood of becoming vaccinated. Among the unvaccinated, additional barriers were identified. However, a significant number reported that mandatory vaccination requirements would increase their likelihood of becoming vaccinated.

A national study by Miller et al. (2011) provided more in-depth information on the vaccination strategies used by 808 hospitals across the United States. The study aimed to determine institutional requirements ranging from declination policies to mandatory work requirements. A survey was mailed to 998 acute care hospital administrators. Influenza vaccination rates were reported by 440 institutions of 808 institutions studied. Data were weighted to account for non-responses in univariate and multivariate analysis. The study findings indicated that overall, rates improved from 62% pre-requirement to 76.6% post requirement. Vaccination rates were higher among hospitals that implemented consequences for vaccine refusal. Based on the findings, the authors recommended that hospitals may consider using multi-faceted voluntary vaccination strategies and internal organizational mandates for assuring higher vaccination rates.

Ethics and Influenza Vaccination

According to Tilburt et al. (2008), ethical considerations surrounding the mandates of vaccinations have been debated within scientific societies. The pandemic spread of influenza due to the antigenic shift and drift of the virus may add a considerable pressure to mandate the vaccination especially in a high-risk group such as HCP. Some research articles used in this chapter suggest that biomedical ethics principles consider the welfare of exposed individual placed at risk of unvaccinated HCP (van Delden et al., 2008). Hence, the mandates of vaccination for HCP are meeting the basic ethical principles (Tilburt et al., 2008;).

The ethical argument surrounding mandated influenza vaccinations requires that voluntary vaccination programs for those caring for frail and elderly patients deserve additional consideration (Tilburt et al., 2008; van Delden et al., 2008). Significant harm can be caused by declining vaccination by HCP. Therefore, the professional duty of balancing benefit over risk may fail and become an ethical dilemma (van Delden et al., 2008).

Vaccinations are assumed to reduce harm; therefore, ethically justifying vaccination requirements for HCP. Alternatively, vaccinations can be seen as morally wrong if they involve causing harm to others. Another ethical consideration of mandatory vaccination of HCP is that it assumes an element of moral superiority. It has, however, been found that voluntary vaccination has proven ineffective in reaching stated coverage goals, causing a moral and ethical quandary (van Delden et al., 2008).

One of the ethical arguments against mandatory vaccination is the freedom of choice to refuse vaccination (Tilburt et al., 2008; van Delden et al., 2008). In debating for or against mandatory vaccination, these researchers noted one may argue that moral responsibility and accountability are the winning arguments against declining vaccination rates among HCP In this case, they claimed justification of mandatory vaccination to reduce harm would be a legitimate argument to constrain freedom of choice (van Delden et al., 2008).

The cost of tracing non-compliant employees may cause a financial burden to health care organizations and could be seen as an ethical implication (see van Delden et al., 2008). However, the cost involved in the implementation of a voluntary vaccination program, including additional education, and improving the accessibility of the vaccination to reach all HCP can also potentially place a tremendous financial burden on health care institutions (van Delden et al., 2008).

Patients and residents within the health care system place a great deal of trust in their caregivers. The healing professions are perceived as virtuous, trustworthy, compassionate, and void of self-interests (Tilburt et al., 2008). The virtuosity of a professional obligation is seated in service to a patient. The "prima facie" implies that a health care career comes with obligations and duties to the patient. Vaccinations are assumed to comply with all reasonable measures to deliver safe and effective care to the patient. The action involved in preventing transmission of influenza relies on organizational leadership within the health care network. Basic recommendations found under the ethics of mandatory requirement of influenza vaccination included education and communication of influenza as a patient safety problem.

Tilburt et al. (2008) argued that all prospective employees should be notified of the mandatory requirement at the time of hire and informed of policies regarding the failure to comply with immunization mandates. Organizational policies should be clear, inclusive, compelling, and provide an easy procedure for coverage. Policies should also describe processes for handling adverse events related to vaccine administration and disciplinary actions taken against noncompliant HCP. They also found that transparency is an essential aspect in the success of implementation to communicate the rate of vaccination and to provide a balanced approach to all staff without excluding any staff regardless of his or her seniority or position within the organization.

Barriers of Influenza Vaccination Intakes

Barriers to the uptake of influenza vaccination are a subject intensively studied to assess methods for improving vaccination rates. A study aimed to examine the barriers to HCP vaccination enrolled 1,701 full-time HPC between 18 and 65 years of age (Naleway et al., 2014). The vaccination coverage was 77% with higher vaccinated rates associated with age increases, marital status, practitioner role, years in clinical practice, job satisfaction, and history of vaccination. Additional reasons for vaccination among HCP were related to the convenience of vaccination, self-protection, patient protection, and protection of family and friends. Among those who declined vaccination, around half indicated they would have been vaccinated if the employer required mandatory vaccination. Strong concerns about safety, effectiveness, and perception of low susceptibility were cited as barriers to vaccination.

Another study aimed to examine the social and cognitive variables associated with the choice to be vaccinated (Lehmann et al., 2014). The fear of side-effects and the belief that the body can fight the virus without the vaccination were found to be the most substantial barriers to vaccination among non-immunized HCP. Most non-immunized HCP never had a flu immunization, feared potential side effects, or were influenced by the opinions of colleagues. Non-immunized HCP were more likely to feel hand hygiene and staying home when ill, were as effective as immunization for protecting patients from the transmission. Also, non-immunized HCP highly valued freedom of choice.

Summary

HCP and patients are at risk of acquiring the influenza virus. HCP may transmit the virus from patient to patient by moving the virus across different surfaces or while providing direct patient care. The risks of disease transmission from HCP to patients are lower when HCP are vaccinated. Despite such knowledge, the HCP influenza vaccination intake varies among different groups of HCP. The common reasons for the differences in vaccination rates relate to HCP perceptions of low vaccine efficacy, fear of vaccination, and perception of low risk of acquiring the virus. Higher vaccine intake was associated with incentives, accessibility or convenience of vaccination during work, HCP education on vaccine myths, desire to protect patients, knowledge of disease transmission and illness risk, an employer mandate, or encouragement.

Numerous studies were reviewed in this chapter to illustrate the importance of HCP influenza vaccination, influenza virus transmission, and various recommendations and strategies to improve HCP influenza vaccination rate. Despite the wealth of studies that have examined the vaccination rate over the years, there remains significant room for improvement, especially in specific clinical settings. 2013c Having a shared belief system may increase the likelihood of vaccine intakes, such as the belief of protection such as self-protection, patient-protection, and protection of family and friends (Naleway et al., 2014). Also, mandatory vaccination may enhance the awareness of the need for higher vaccination rates among HCP. However, the real impact of such policies is not well understood at present.

This study was designed to explicitly reveal the influence and impact of a legislative policy requiring mandatory reporting of HCP vaccination rates on the uptake of influenza vaccinations among HCP. Chapter 3 will detail the methodology for conducting this study.

Chapter 3: Research Method

Introduction

The purpose of this quantitative study was to describe the effects of the 2012 influenza vaccination reporting mandate on HCP vaccination rates by examining trends in influenza vaccination rates among HCP within the AH network. The required reporting of HCP influenza vaccination coverage is part of the Centers for Medicare & Medicaid Services (CMS) Inpatient Quality Reporting Program through the Center for Disease Control and Prevention (CDC) (CDC, 2012a).

Despite recommendations for increasing influenza HCP vaccination rates, national vaccination rates hovered at approximately 45% before the reporting mandate (Talbot & Schaffer, 2010). The Healthy People 2020 (HP) goal of 90% influenza vaccination rates among HCP came after this discovery, and yet current published national rates averaged approximately 60% (CDC, 2012a). Thus, there was a clear need to improve vaccination rates and to evaluate how requirements such as the mandatory reporting requirement may influence HCP influenza vaccination rates. This study aimed to describe trends in vaccination rates over eight years with data from the AH network and to assess factors associated with vaccination uptake.

This study was designed to provide insight on the impact of the CMS' mandatory reporting requirements that went into effect starting the 2011-2012 influenza season on HCP vaccination rates within an extensive health care network. HCP vaccination rates were evaluated for one year before the reporting mandate (i.e., the 2010-2011 influenza season, or baseline season), the intervention influenza season (2011-2012), and four consecutive post-mandate influenza seasons (2012-2016). The results provided information about practical approaches to bolster vaccination uptake among HCP to bring these rates toward the HP 2020 goal. In this chapter, I discuss the research design, the study sample and setting, and the analysis plan. I conclude with a discussion of the ethical protection of participants' rights and information privacy..

Research Design and Rationale

This study used a nonexperimental design with both primary and secondary data.. For the secondary data, a retrospective cohort design as employed, involving analysis of historical HCP vaccination data from the AH network for the influenza seasons before and after the mandatory reporting requirement occurred. Retrospective cohort design uses existing data to assess data trends and patterns for events that occurred in the past.

HCP vaccination rates for the premandatory reporting seasons 2010/2011,2011/2012, 2012/2013, and 2013/2014 were obtained from hospital administrators survey, and HCP vaccination rate for postmandatory reporting season 2014/2015,2015/2016, 2016/2017, and 2017/2018 seasons were obtained from CMS, which utilizes the National Healthcare Safety Network (NHSN) as standard data collection model for participating health care networks. Reported HCP vaccination rates were then compared across the eight influenza seasons to determine whether the introduction of the mandatory reporting requirement in the 2011/2012 influenza season affected vaccination rates.

Primary data was collected by distributing a 10-item questionnaire to the hospital administrators responsible for staff immunization records and employee wellness at the same hospitals. The purpose of the questionnaire was to derive insight about the interventions and strategies each hospital used to promote vaccination among its HCP.

Methodology

Research Setting

The setting of the proposed study consisted of 21 hospitals operating as part of the AH network. The AH network is a faith-based, non-profit, and community-based health care organization (Adventist Health, 2022). The organization has served more than 80 communities on the West Coast and Hawaii and was founded on the Seventh-day Adventist heritage. At the time of this study, the network provided care through hospitals, clinics, hospice agencies, home care agencies, and joint-venture retirement centers. The mission was “Living God’s love by inspiring health, wholeness, and hope”. In 2016, the hospitals in this study had the following total numbers of health care encounters by service type:

- inpatient hospital admissions: 150,202
- emergency visits: 685,296
- outpatient visits: 2,952,313
- home care visits: 239,742
- clinic visits: 2,283,341

Research Population

The universal sample for this study based on the G*power sample size computation was the 21 hospitals currently operating as part of the AH network. The hospitals were located in the states of California, Oregon, and Hawaii (Adventist Health, 2022). There was a total of 35,000 HCP within the AH network that included physicians, nurses, care partners, and others.

Sampling Strategy

A universal sampling strategy was adopted, which means that the sample and the populations are the same (Hanington & Martin, 2012). All 21 hospitals operating as part of the AH network were included in the final sample.

Instrumentation and Material

Information about vaccination rates was obtained from publicly available sources. For the primary data collection component in this study, data were gathered using a questionnaire that was prepared and administered to hospital administrators. The questionnaire was used to obtain data on the preparation and readiness of health care networks to meet the Healthy People 2020 Immunization and Infectious Disease goal IID-12.13 to increase the percentage of HCP who were vaccinated annually against seasonal influenza.

The questionnaire was formatted and distributed through SurveyMonkey®, Inc., as an online survey (Appendix B). SurveyMonkey® is an online survey software service that provides customizable studies, data analysis, sampling tools, and on time descriptive analysis of data. Publicly available data from CMS and the responses from SurveyMonkey® were converted from Excel format to SPSS (Statistical Package for Social Science)for hypothesis testing and analysis.

Operationalization

Research Variables

The research variables are summarized in Table 1. There were three main variables in this study:

- *Vaccination rate* was a continuous variable that represents the percentage of HCP vaccinated in each influenza season.
    - The possible range is 0%-100%.
- *Intervention* was the first measure of non-mandate organizational strategies and is a categorical variable constructed from five attribution-scale variables. The average score of response of five items could range from 1-5.
    - Each hospital has scored the effectiveness for each strategy using a score of 1 - very ineffective, 2 - somewhat ineffective, 3 - neither effective or ineffective, 4 - somewhat effective, and 5 - very effective:

1. The hospital provides a free vaccine at the workplace.
2. The hospital provides a robust educational program for staff.
3. The hospital establishes a culture of prevention.
4. The hospital maintains up-to-date knowledge with the guidelines.
5. The hospital incentivizes staff through a wellness program.

The five scores were then averaged to reach a composite score of interventions with a range of 1-5.

- *Number of HCP per facility* was the second measure of non-mandate organizational strategies and was an ordinal measure variable constructed with three ordinal scales of 1 = Small <500, 2 = Medium between 500-1000, and 3 = Large > 1000.

Table 1

Research Variables

RQ	*Outcome name*	*Variable*	*Variable description*	*Type of data*
RQ1	Vaccination rates	Dependent Variable	Percentage of HCP vaccinated in each of influenza season.	Continuous (percentage)
RQ1	Season	Independent Variable	Each flu season from the pre-mandatory requirement to 6 continues seasons after that.	Categorical (year)
RQ2	Vaccination rates	Dependent Variable	Percentage of HCP vaccination rate per each of the 21 AH hospitals	Continuous (percentage)
RQ2	Season	Independent Variable	Each flu season from the pre-mandatory requirement to 6 continues seasons after that.	Categorical (year)
RQ3	Vaccination rates for 2015/2016 flu season	Dependent Variable	Percentage of HCP vaccinated for 2015/2016 flu season.	Continuous (percentage)
RQ3	Interventions composite score	Independent Variable	Assigned intervention score based on five variables	Categorical
RQ3	Number of HCP per facility	Independent Variable	HCP size: -Small <500 -Medium between 500-1000 -Large > 1000	Ordinal

Data Analysis Plan

The data were analyzed using SPSS 20. The analysis was divided into two stages. The first stage was used to compute basic descriptive statistics (e.g., frequencies, percentages, means, and standard deviations) to summarize patterns in the data.

The second phase involved hypothesis testing using a combination of bivariate and multivariate approaches. That analytical procedure is now specified, depending on the hypothesis to be tested.

Research Question 1

RQ1: To what extent, if any, have the influenza immunization rates for HCP employed by the AH network significantly changed since the reporting mandate was introduced in 2012?

> $H1_0$: There have been no significant changes in the overall influenza vaccination rates of HCP employed by the AH network since the introduction of mandatory vaccination reporting in 2012.
>
> $H1_a$: There have been significant changes in the overall influenza vaccination rates of HCP employed by the AH network since the introduction of mandatory vaccination reporting in 2012.

A paired samples *t* test was conducted to address research question one. A paired samples *t* test can be used to evaluate the data from a pre/post-intervention by comparing two means from the same population concerning the same variable at two different times. The data are paired data since the same HCP was observed at different seasons. The dependent variable was the actual rate of influenza immunization for HCP and the independent variable was the season (year). The rationale for utilizing the paired samples *t* test was (a) one similar question was asked pre-and post-mandate for comparison, and (b) the same HCP would be completing the survey both pre-and post-mandate. A level of significance of .05 was used in the paired samples *t* test. There would be a significant differences in the actual rate of influenza immunization rates for HCP at different seasons if the *p* value of the *t* statistics of the paired samples *t* test was less than or equal to the level of significance value of .05. If significant differences were observed, the mean differences of each pair difference would be compared to determine the magnitude of the differences.

Two assumptions underlie the paired samples *t* test (Green & Salkind, 2016):

- Assumption 1: the distribution of the differences in the dependent variable between the two related groups should be approximately normally distributed. Normality was tested using the Shapiro-Wilk test of normality. However, it should be noted that the paired samples *t* test is quite robust to violations of normality, meaning that the assumption can be a little violated and still provide valid results.
- Assumption 2: There should be no significant outliers in the differences between the two related groups. The problem with outliers is that they can have a negative effect on the paired samples *t* test, reducing the validity of the results. Boxplots of the data of the dependent variable across the different groupings were created to detect the presence of outliers.

Using SPSS, the 20 hospitals were assessed for eight consecutive influenza seasons starting from 2010/2011 season and ending by 2017/2018 season. For the paired samples *t* test, the means of pre-mandatory influenza vaccination rate for four seasons (2010/2011, 2011/2012, 2012/2013, and 2013/2014) were compared to the means of post-mandatory influenza vaccination rate for four seasons (2014/2015, 2015/2016, 2016/2017, and 2017/2018). The aim was to evaluate the change in the HCP vaccination rate pre-versus post-mandate and post-mandate versus post-mandate over time.

Research Question 2

RQ2: Are reported influenza vaccination rates comparable between the 21 hospitals affiliated with the AH network?

$H2_0$: There are no significant differences in the influenza vaccination rates of HCP between hospitals affiliated with the AH network.

$H2_a$: There are significant differences in the influenza vaccination rates of HCP between hospitals affiliated with the AH network.

These hypotheses were tested using a repeated measures ANOVA. Before implementing the repeated measures ANOVA, the analysis tested to see if the data met the following assumptions (Green & Salkind, 2016):

- Assumption 1: the dependent variable (Percentage of HCP vaccination rate) is usually distributed for each of the populations (each of the 21 hospitals). The repeated measures ANOVA may yield reasonably accurate *p*-value even when the normality assumption is violated. A commonly accepted sample size is 30 subjects.

- Additionally, the power of the *p*-value test may be reduced when the population distribution has thick-tailed or heavily skewed. Normal plots for the data from the 21 facilities could be used to suggest the assumption of normality is "reasonable." The main goal is to test for gross violation of the normality assumption.
- Assumption 2: The population variance of difference scores computed between any two levels is the same value. This assumption is also referred to as the sphericity assumption nor as to the homogeneity-of-variance-of differences assumption. This assumption is violated when the *p*-value cannot be trusted. Multivariate and univariate approaches could be used to correct the degree of freedom and account for violation of this assumption. Fortunately, SPSS Statistics makes it easy to test whether the data has met or failed this assumption by performing Mauchly's test of sphericity in SPSS Statistics (Green & Salkind, 2016).
- Assumption 3: The cases represent random samples from the populations, and there is no dependency on the scores between participants. In this assumption, the only dependency among participants (hospitals) is introduced when participants produce multiple scores.

The repeated measures ANOVA is a very robust test. However, if any of the assumptions are grossly violated, then the reliability of the computed test and the related *p*-value may be compromised (Green & Salkind, 2016).

Research Question 3

RQ3: Are vaccination rates associated with non-mandate organizational strategies other than the 2012 reporting mandate?

$H3_0$: There are no significant associations between non-mandate organizational strategies and reported vaccination rates in hospitals affiliated with the AH network.

$H3_a$: There are significant associations between non-mandate organizational strategies and reported vaccination rates in hospitals affiliated with the AH network.

These hypotheses were tested using multiple linear regression analysis. The dependent variable was vaccination rates, while the intervention measures collected through the questionnaire were entered as the independent variables.

Multiple linear regression analysis is commonly used for predictive analysis to describe and explain the relationship between the dependent and the independent variables. Three significant assumptions are part of conducting the multiple linear regressions analysis (Green & Salkind, 2016):

- Assumption 1: The relationship between the independent and dependent variables is linear. This assumption can be tested with scatterplots for either curvilinear relationship or a linear relationship. If the multivariate normality assumption is met, the statistical relationship that can exist between the variables is a linear relationship.

- Assumption 2: The error between observed and predicted values should be normally distributed. This assumption can be checked using a histogram or a Q-Q-plot. The normality then can be examined with a goodness of fit test.
- Assumption 3: Multiple linear regression analysis assumes no multicollinearity in the data that occurs due to highly correlated independent variables with each other. The multicollinearity can be checked through computing the correlation matrix among all independent variables and Variance Inflation Factor. Although, the simplest solution is to find the variables causing multicollinearity issues and removing those variables from the regression. If the independence assumption is violated, the *F* test yields inaccurate *P* value.

Threats to Validity

Reliability and validity are interrelated (Trochim, 2006). Establishing validity and reliability is an essential part of quantitative research. The data for this study were obtained from a secondary source (CMS data and NHSN Data). Internal validation occurs through the active efforts of the reporting facilities to assure completeness and accuracy of the NHSN data. External validation occurs through the activities of a third-party agency contracted with NHSN to conduct a survey and audit process (CDC, 2017).

An original questionnaire was also created after developing a thorough understanding of the research and theoretical framework to inform statements, research questions, measurements, and questionnaire format. Although approximately a third of studies using original questionnaires do not report procedures for establishing validity or reliability, development of a valid and reliable questionnaire is critical for reducing measurement error (Trochim, 2006). The questionnaire was pilot tested to confirm the reliability of the questionnaire instrument with one or two experts in the field of employee health or infection prevention and who were familiar through their job duties with HCP vaccination and the data collection for mandatory reporting.

Dissemination of Results

The results of this study were shared with the AH network through the employee health department as well as with the president of each facility. The findings may be used to plan future enhancement of the influenza vaccine program within the network. This research may also be useful for other hospital networks to follow and tailor to their initiatives. Finally, the research results will be submitted for presentation at the Associate of Professional in Infection Control (APIC) annual conference, American Journal for Infection Control (AJIC), and other professional meetings in the infectious disease therapeutic field.

Ethical Procedures

I did not directly study human participants but instead used hospital information from a questionnaire and from data in the public reporting system. Since I hold a senior position in one of the AH network hospitals, the questionnaires were issued through SurveyMonkey to ensure anonymity and reduce response bias (Trochim, 2006). Data confidentiality procedures were explained through informed consent in the questionnaire. The raw hospital data, hard copies, and a USB port with the questionnaire responses were stored in a locked drawer in an office that was locked while unattended during the research period. No personally identifiable information was reported in the research study, only aggregate data. The study was approved by both the Walden University (10-03-19-0077780) and AH network Institutional Review Boards (IRBs). All data collection requirements were met before the commencement of the data collection stage.

Procedures for data collection and handling complied with the Walden University IRB. Part of the study was carried out using secondary data from NHSN, which was accessed from a remote work environment. The office I used for work is the same office I used for research, but with different workstations and computers. The office is a locked office with access limited by identification cards assigned by the organization. Virtual and electronic data were maintained in a hospital-issued computer and secured within the hospital property. Data access was restricted to me and to my committee members if deemed necessary for dissertation review and guidance. All collected data was stored in a password-protected database that was not accessible to anyone other than the researcher, members of the dissertation committee, and a statistical analyst if needed (See Appendix C). After the completion of the study and the dissertation, all electronic and paper data sources were moved to a locked safe and will be maintained for five years before being shredded and destroyed. This data protection plan ensures the confidentiality of participants.

The hospital-level data used in the study was approved for collection by the AH network IRB, and a business agreement was signed as necessary with Health Insurance Portability and Accountability Act (HIPAA) language for data protection.

Summary

The impact of the CMS mandatory reporting requirements of 2012 and the impact of AH organizational policies on HCP vaccination rates for HCP employed by the AH network during eight years were examined in this study. At the time of the study, the faith-based health care organization had 21 operational hospitals located in California, Oregon, and Hawaii. The non-experimental study used three quantitative tests to analyze the data and answer the research questions. Vaccination coverage data are reported to the public health departments and were examined using different models to identify significant changes over the four influenza seasons since the CMS mandates. Additionally, hospital administrators for each hospital were invited to complete a short online questionnaire.

In the next chapter, I present the data collected and the results of the statistical analysis conducted to answer each of the research questions. I have reported any additional statistical tests of the research hypotheses and included tables and figures to illustrate the research results.

Chapter 4: Results

Introduction

The purpose of this quantitative study was to describe the effects of the 2012 influenza vaccination reporting mandate on HCP vaccination rates by examining trends in influenza vaccination rates among HCP within the AH network. The required reporting HCP influenza vaccination coverage is part of the CMS Inpatient Quality Reporting Program through CDC (CDC, 2012a). More specifically, I examined whether the 2012 influenza vaccination reporting mandate was associated with a change in vaccination rates among HCP within the AH network of hospitals. In addition, I examined whether vaccination rates among HCP following the 2012 influenza vaccination reporting mandate differed significantly between hospitals in the AH network. Lastly, I examined whether there were significant associations between nonmandate organizational strategies and reported vaccination rates in hospitals affiliated with the AH network.

The research questions and hypothesis statements for this research project were:

RQ1: To what extent, if any, have the influenza immunization rates for HCP employed by the AH network significantly changed since the reporting mandate was introduced in 2012?

$H_0$1: There have been no significant changes in the overall influenza vaccination rates of HCP employed by the AH network since the introduction of mandatory vaccination reporting in 2012.

H_a1: There have been significant changes in the overall influenza vaccination rates of HCP employed by the AH network since the introduction of mandatory vaccination reporting in 2012.

RQ2: Are reported influenza vaccination rates comparable between hospitals affiliated with the AH network?

H_02: There are no significant differences in the influenza vaccination rates of HCP between hospitals affiliated with the AH network.

H_a2: There are significant differences in the influenza vaccination rates of HCP between hospitals affiliated with the AH network.

RQ3: Are vaccination rates associated with organizational strategies other than the 2012 reporting mandate?

H_03: There are no significant associations between non-mandate organizational strategies and reported vaccination rates in hospitals affiliated with the AH network.

H_a3: There are significant associations between non-mandate organizational strategies and reported vaccination rates in hospitals affiliated with the AH network.

In this chapter, I will describe the data collection process as well as the results of the data analysis. I will provide interpretation of these findings in Chapter 5.

Data Collection

Data files were downloaded from archival Medicare-Hospital Compare data sets (CMS, 2019). The data files included the mandatory reporting measure relevant for the study, namely the influenza vaccination rate among HCP for each hospital per influenza season. Separate Excel files were downloaded for each of the eight influenza seasons between 2012 and 2018 from the Medicare-Hospital Compare data that includes the results of all mandatory reporting measures by hospitals and merged into one dataset (CMS, 2019). Each file was filtered by the list of the AH hospitals.

Additional survey data collected from the hospital administrators from each hospital to assess organizational strategies were merged in one database using SPSS. In total, eight seasonal influenza vaccination rates were obtained from the hospital survey, including four seasons before the mandatory reporting requirement: 2010/2011, 2011/2012, 2012/2013, and 2013/2014 and four seasons after the mandatory reporting requirement: 2014/2015, 2015/2016, 2016/2017, and 2017/2018.

Descriptive Analysis

The total number of hospitals initially included in the influenza vaccination rate analysis was 21 hospitals. After data collection, it was found that one of the hospitals was not impacted by the mandate and did not keep consistent records of the influenza vaccination rate. Hence, the hospital was removed and only 20 hospitals were included in the population. All hospitals were in California except for three hospitals located in Oregon (Portland and Tillamook) and Hawaii (Castle). Table 2 to Table 11 provide a general descriptive analysis related to the AH network and the general practices associated with the influenza vaccination program.

Table 2

AH Network Hospital Size by the Number of HCP and Bed Counts (n=20)

Variables	Min	Max	*M*	*SD*
Hospital Size by number of HCP	248	3940	1625.90	1017.51
Bed Count	25	415	145.50	111.84

Table 3

Bed Size of Hospitals in the AH Network (n=20)

Variables	Frequency	%
Small <100	9	45.0
Medium: between 100-174	5	25.0
Large >174	6	30.0

Table 4

AH Network Requirement of Influenza Vaccine Declination Statement (n=20)

Variable	Frequency	%
Yes	20	100

Table 5

AH Network Education Requirement for Those Who Declined the Vaccine (n=20)

Variable	Frequency	%
No	6	30.0
Yes	14	70.0

Table 6

AH Network Mask Requirement for Those Who Declined the Vaccine (n=20)

Variable	Frequency	%
Yes	20	100

Table 7

AH Network Influenza Vaccination as a Condition of Employment (n=20)

Variable	Frequency	%
No	19	90.0
Yes	1	10.0

The hospital administrators reported their data prior to the reporting mandate for a total of four seasons (2010/2011,2011/2012,2012/2013, and 2013/2014) through the survey. For the influenza vaccination rates after mandatory reporting, the hospitals had data available through Hospital-Compare for four seasons (2014/2015, 2015/2016, 2016/2017, and 2017/2018). Influenza vaccination rates for each season are displayed in Table 8.

Table 8

Influenza Vaccination Rate Across AH Network Hospitals by Season (n = 20)

	M	*SD*
2010-2011	58.7%	0.206
2011-2012	62.0%	0.167
2012-2013	64.5%	0.146
2013-2014	66.9%	0.116
2014-2015	74.4%	0.138
2015-2016	75.0%	0.145
2016-2017	80.2%	0.114
2017-2018	79.2%	0.099

Data were collected in the survey sent to the hospital administrators, and 21 hospital administrators responded to the survey. As mentioned above, one hospital was removed, and the survey now includes a total of 20 hospitals without any missing data. Table 9 represents the hospital administrators' rating on the effectiveness of mandatory reporting in increasing influenza vaccination rates at their hospital, at the organization, and in general. There was a consistency of the level of effectiveness within the responses at all three levels mentioned above. As shown in Table 9, hospital administrators reported of mandatory vaccination reporting had a degree of effectiveness in increasing the influenza vaccination rate but without certainty.

Table 9

Participants' Responses on the Effectiveness of Mandatory Reporting in Increasing HCP Influenza Vaccination Rate (n=20) by percentage

Variables	Very Effective	Somewhat Effective	Neither effective nor ineffective	Somewhat ineffective	Very ineffective
At Your Hospital	10.0	50.0	15.0	15.0	10.0
At AH	10.0	55.0	20.0	10.0	5.0
At All Healthcare Facilities	15.0	55.0	15.0	10.0	5.0

Hospital administrators were asked to rate the effectiveness of different practices in preventing the spread of influenza in their hospital environment. As shown in Table 10, 80.0% believed that the *influenza vaccine* is *very effective* in preventing the spread of influenza in the hospital environment, and 85.0% believed that *hand hygiene* is *very effective* in preventing the spread of influenza in the hospital environment.

Table 10

Participants' Responses on the Effectiveness of Different Practices in Preventing the Spread of Influenza in Hospital Environment (n=20) by Percentage

Variables	Very Effective	Somewhat Effective	Neither effective nor ineffective	Somewhat ineffective	Very ineffective
Influenza Vaccine	80.0	20.0	0.0	0.0	0.0
Covering Mouth with Mask	65.0	30.0	5.0	0.0	0.0
Use of Mask Only	50.0	30.0	10.0	5.0	5.0
Use of Gloves Only	65.0	25.0	0.0	5.0	5.0
Hand Hygiene	85.0	15.0	0.0	0.0	0.0

Hospital administrators were asked to rate the effectiveness of the different organization strategies to increase the influenza vaccination rate among HCP. As shown in Table 11, 70.0% believed that providing a *free influenza vaccine* effectively increased the influenza vaccination rate among HCP.

Table 11

Participants' Responses on the Effectiveness of Different Organizations' Strategies in Increasing The Influenza Vaccination Rate among HCP (n=20) by Percentage

Variables	Very Effective	Somewhat Effective	Neither effective nor ineffective	Somewhat ineffective	Very ineffective
Free Influenza Vaccination	70.0	25.0	5.0	0.0	0.0
Robust Educational Program	45.0	45.0	10.0	0.0	0.0
Establishing Prevention Culture	40.0	50.0	10.0	0.0	0.0
Maintaining Knowledge of the Guidelines	40.0	50.0	10.0	0.0	0.0
Incentivizing HCP through a Wellness Program	40.0	45.0	5.0	5.0	5.0

Results

As described in Chapter 3, three research questions were addressed through statistical analysis. These questions aimed to explore the relationship between mandatory influenza vaccine reporting and the influenza vaccine rate among HCP. In the literature review in Chapter 2, the HCP influenza vaccination rate historically showed very low compliance and a goal of 90% HCP influenza vaccination rate was accepted as one of the measures under Healthy People 2020 (National Vaccine Advisory Committee, 2013). Beyond the mandatory reporting, there are many strategies that hospitals use to improve HCP influenza vaccination rate such as declination statements, mandatory education for all HCP who decline the vaccine, wearing a mask during influenza season for those who decline the vaccine, incentivizing influenza vaccination through a wellness program, and mandatory vaccination as a condition of employment (Babcock et al., 2010; Rakita et al., 2010).

Research Question 1

To what extent, if any, have the influenza immunization rates for HCP employed by the AH network significantly changed since the reporting mandate was introduced in 2012?

$H_0$1: There have been no significant changes in the overall influenza vaccination rates of HCP employed by the AH network since the introduction of mandatory vaccination reporting in 2012.

H$_a$1: There have been significant changes in the overall influenza vaccination rates of HCP employed by the AH network since the introduction of mandatory vaccination reporting in 2012.

A paired samples *t* test was conducted with the use of data collected from the survey and Hospital-Compare to examine if the influenza vaccination rate changed after the mandatory reporting. Results of the paired samples *t* test showed that the mean difference of influenza vaccination rate after mandatory reporting, $M = 0.14$,$SD = 0.20$, 95% *CI* [0.046, 0.237], was statistically significant at the 0.05 level of significance ($t = 3.11$, $df = 19$, $p < .05$). The null hypothesis, which suggested no significant difference in the mean influenza vaccination rate after mandatory reporting was rejected. Table 12 and Table 13 display the results from the paired samples t test.

Table 12

Research Question 1: Influenza Vaccination Rate Across AH Hospitals Pre-and Post-Mandatory Reporting Requirement (n=20).

Influenza Vaccination Rate	*M*	*SD*	*SEM**
Before Mandatory Reporting Avg. 2010-2013 [seasons 2010-2011,2011-2012, 2012-2013, 2013-2014]	63.0%	0.15	0.035
After Mandatory Reporting Avg. 2014-2018 [seasons 2014-2015, 2015-2016, 2016-2017, 2017-2018]	77.0%	0.10	0.024

Note: *SEM represent Standard Error of Measurement

Table 13

Research Question 1: Difference in Mean Influenza Vaccination Rate Before Mandatory and After Mandatory Reporting (n=20).

Paired Differences			95% Confidence Interval of the Difference		*t*	*df*	*p*
M	*SD*	*SEM**	Lower	Upper			
14.1%	0.203	0.046	0.046	0.237	3.110	19	.006

Note: *SEM represents Standard Error of Measurement

Research Question 2

Are reported influenza vaccination rates comparable between hospitals affiliated with the AH network?

$H_0 2$: There are no significant differences in the influenza vaccination rates of HCP between hospitals affiliated with the AH network.

$H_a 2$: There are significant differences in the influenza vaccination rates of HCP between hospitals affiliated with the AH network.

A one-way repeated measures analysis of variance (ANOVA) test was conducted to examine the association between the different seasons and hospitals' vaccination rates. The results of the ANOVA test indicated there was no significant difference between each season and hospitals' vaccination rates, Wilk's Lambda = 0.581, $F(5,15) = 2.165$, $p = .113$.

The Mauchly's Test of Sphericity in Table 14 indicated an error of covariance matrix of the orthonormalized transformed variables (Green & Salkind, 2016). As described in Chapter 3, sphericity is an important assumption of a repeated measures ANOVA where the population variance of difference scores computed between any two levels is the same value (Green & Salkind, 2016). When this assumption is violated, the p-value cannot be trusted (Green & Salkind, 2016).

SPSS includes a few corrections that could be used in this event. One is the Greenhouse-Geisser and the second is Huynh-Feldt. Based on the value of these two tests, I interpreted the p-value associated with Greenhouse-Geisser for tests of within the subjects' effects (Table 15).

In summary, the one-way repeated measures ANOVA was conducted to examine if there were differences in the influenza vaccination rate reported by the hospitals for the eight available seasons. Normality checks were carried out on the residuals which were approximately normally distributed. Pairwise comparisons between the influenza vaccination rate and each of the reported seasons are displayed in Table 16. Mauchly's test indicated that the assumption of violation of sphericity had been violated, therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity (ε = 0.218). The results showed the influenza vaccination rate means differed significantly between reported seasons, $F(1.529, 29.045) = 8.43$, $p = .003$). The null hypothesis, which suggested no significant differences in the influenza vaccination rates of HCP between hospitals affiliated with the AH network was rejected.

Table 14

RQ2 Mauchly's Test of Sphericity (n=20)

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	*df*	*p*	Epsilon		
					Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Vaccine	.000	.	27	.	.218	.234	.143

Table 15

RQ2 One-way Repeated Measures Analysis of Variance (ANOVA) Influenza Vaccination Rates by Season (n=20).

	Type III Sum of Squares	*df*	Mean Square	*F*	*p*
Greenhouse-Geisser	.928	1.529	.607	8.430	.003

Table 16

RQ2 Pairwise Comparisons: One-way Repeated Measures Analysis of Variance (ANOVA) Influenza Vaccination Rates by Season (n=20).

(I) vaccine	(J) vaccine	Mean Difference (I-J)	*SE*	p^a	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
2010/2011	2011/2012	-.033*	.010	.003	-.053	-.012
	2012/2013	-.058*	.017	.003	-.094	-.022
	2013/2014	-.082*	.027	.007	-.138	-.026
	2014/2015	-.157*	.055	.010	-.271	-.043
	2015/2016	-.163*	.057	.010	-.283	-.043
	2016/2017	-.214*	.060	.002	-.341	-.088
	2017/2018	-.205*	.061	.003	-.334	-.076
2011/2012	2010/2011	.033*	.010	.003	.012	.053
	2012/2013	-.025*	.010	.016	-.046	-.005
	2013/2014	-.049*	.020	.021	-.090	-.008
	2014/2015	-.124*	.045	.013	-.219	-.029
	2015/2016	-.130*	.048	.014	-.231	-.029
	2016/2017	-.182*	.051	.002	-.288	-.076
	2017/2018	-.172*	.052	.004	-.281	-.064
2012/2013	2010/2011	.058*	.017	.003	.022	.094
	2011/2012	.025*	.010	.016	.005	.046
	2013/2014	-.024	.017	.184	-.060	.012
	2014/2015	-.099*	.043	.034	-.189	-.008
	2015/2016	-.105*	.046	.034	-.201	-.009

(I) vaccine	(J) vaccine	Mean Difference (I-J)	*SE*	p^a	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
	2016/2017	-.156*	.045	.003	-.251	-.062
	2017/2018	-.147*	.046	.005	-.243	-.051
2013/2014	2010/2011	.082*	.027	.007	.026	.138
	2011/2012	.049*	.020	.021	.008	.090
	2012/2013	.024	.017	.184	-.012	.060
	2014/2015	-.075	.043	.097	-.165	.015
	2015/2016	-.081	.046	.095	-.178	.016
	2016/2017	-.133*	.040	.004	-.217	-.049
	2017/2018	-.123*	.040	.006	-.206	-.040
2014/2015	2010/2011	.157*	.055	.010	.043	.271
	2011/2012	.124*	.045	.013	.029	.219
	2012/2013	.099*	.043	.034	.008	.189
	2013/2014	.075	.043	.097	-.015	.165
	2015/2016	-.006	.014	.677	-.036	.024
	2016/2017	-.058*	.025	.035	-.111	-.004
	2017/2018	-.048	.028	.104	-.107	.011
2015/2016	2010/2011	.163*	.057	.010	.043	.283
	2011/2012	.130*	.048	.014	.029	.231
	2012/2013	.105*	.046	.034	.009	.201
	2013/2014	.081	.046	.095	-.016	.178
	2014/2015	.006	.014	.677	-.024	.036
	2016/2017	-.052	.028	.076	-.109	.006
	2017/2018	-.042	.031	.184	-.106	.022
2016/2017	2010/2011	.214*	.060	.002	.088	.341
	2011/2012	.182*	.051	.002	.076	.288
	2012/2013	.156*	.045	.003	.062	.251
	2013/2014	.133*	.040	.004	.049	.217
	2014/2015	.058*	.025	.035	.004	.111
	2015/2016	.052	.028	.076	-.006	.109
	2017/2018	.009	.014	.495	-.019	.038

(I) vaccine	(J) vaccine	Mean Difference (I-J)	*SE*	p^a	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
2017/2018	2010/2011	.205*	.061	.003	.076	.334
	2011/2012	.172*	.052	.004	.064	.281
	2012/2013	.147*	.046	.005	.051	.243
	2013/2014	.123*	.040	.006	.040	.206
	2014/2015	.048	.028	.104	-.011	.107
	2015/2016	.042	.031	.184	-.022	.106
	2016/2017	-.009	.014	.495	-.038	.019

Note: * The mean difference is significant at the .05 level.

Furthermore, multivariate and univariate approaches can be used to correct the degree of freedom and account for the violation of sphericity assumption encountered in the above one-way repeated measures ANOVA (Green & Salkind, 2016). The Pearson correlation was appropriate because the R-value provides the strength and direction of any relationship. The value can range from 1.0 to -1.0, with 0 indicating no relationship between the variables and 1.0 indicating perfect correlation (Lund Research Ltd, 2013). The assumptions of the parametric Pearson R correlation analysis were met. The correlation matrix displays the associations between influenza vaccination rates across the different seasons in Table 17.

In addition to the ANOVA, a Pearson correlation coefficient was computed for research question 2 to assess the relationship between the influenza vaccination rate and reported seasons. With the exception of the 2013/2014 season, there was a significant positive correlation between the 2010/2011 and 2011/2012 seasons ($r = 0.995$, $p = .000$), the 2011/2012 and 2012/2013 seasons ($r = 0.971$, $p = .000$), the 2012/2013 and

2013/2014 seasons (*r* = 0.851, *p* = .000), the 2014/2015 and 2015/2016 seasons (*r* = 0.902, *p* = .000), the 2015/2016 and 2016/2017 seasons (*r* = 0.575, *p* = ..004), and the 2016/2017 and 2017/2018 seasons (*r* = 0.848, *p* = .000). However, there was a significant negative relationship between the influenza vaccination rates and reported season before and after-mandatory reporting. For example, there was a significant negative correlation between the 2010/2011 and 2017/2018 seasons (*r* = -0.552, *p* = .006). Based on these results, the null hypothesis, which suggested no significant differences in the influenza vaccination rates of HCP between hospitals affiliated with the AH network was rejected.

Table 17

RQ 2 Correlation Matrix Between Influenza Vaccination Rates by Season (n=20).

	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
2010-2011	--							
2011-2012	.995**	--						
2012-2013	.964**	.971**	--					
2013-2014	.872**	.868**	.851**	--				
2014-2015	.043	.126	.077	-.128	--			
2015-2016	-.024	.055	.016	-.226	.902**	--		
2016-2017	-.359	-.276	-.198	-.214	.610**	.575**	--	
2017-2018	-.552**	-.480*	-.381*	-.346	.476*	.428*	.848**	--

Notes: **. Correlation is significant at the 0.01 level and *. Correlation is significant at the 0.05 level.

Research Question 3

RQ3: Are vaccination rates associated with organizational strategies other than the 2012 reporting mandate?

$H_0$3: There are no significant associations between non-mandate organizational strategies and reported vaccination rates in hospitals affiliated with the AH network.

H_a3: There are significant associations between non-mandate organizational strategies and reported vaccination rates in hospitals affiliated with the AH network.

Multiple linear regression was used to examine the influenza vaccination rates as it related to the organization's use of five different strategies composite of the average effectiveness score. The following were the strategies questions used:

- How effective is providing free influenza vaccination at the workplace in increasing vaccine intake?
- How effective is providing a robust educational program for HCP in increasing vaccine intake?
- How effective establishing a culture of prevention is at increasing vaccine intake?
- How effective is providing up-to-date knowledge with the guidelines in increasing vaccine intake?
- How effective is incentivizing HCP through a wellness program in increasing vaccine intake?

The effectiveness was measured with the following scale: 1 - very ineffective, 2 - somewhat ineffective, 3 - neither effective or ineffective, 4 - somewhat effective, and 5 - very effective. Hospital size was measured by HCP with the following scale: 1 - small < 500 HCP, 2 - medium between 500 – 1000 HCP, and 3 - large > 1000 HCP.

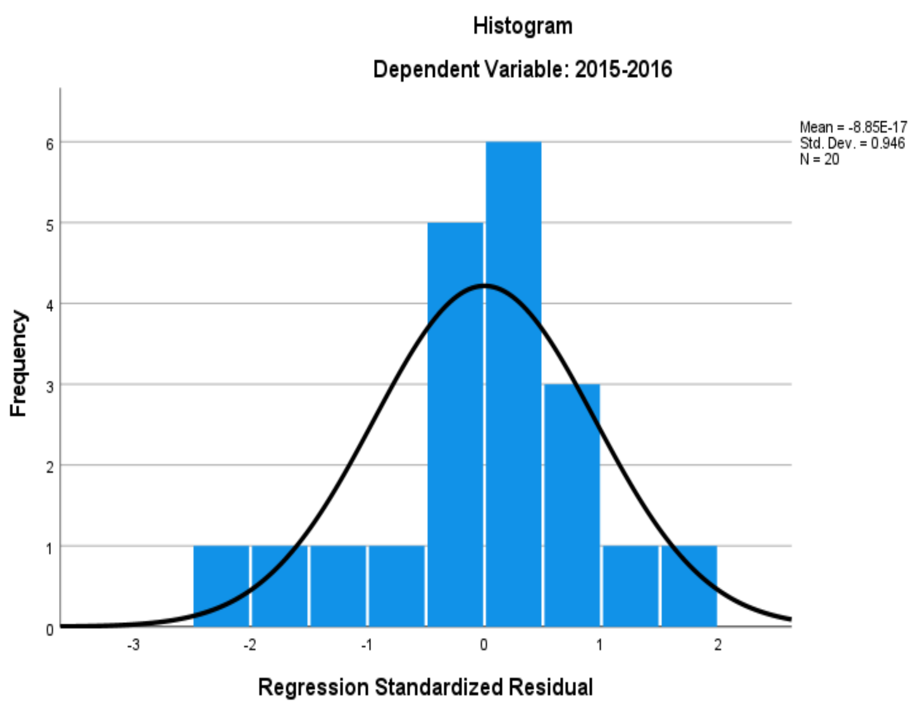
The statistical assumption of multiple regression includes linearity, independence of error, homoscedasticity, multicollinearity, undue influence, and normal distribution errors (Gregoire, 2014). The Durbin-Watson statistic, which provides measurement on the independence of error, was analyzed and reported a value of 1.64. Generally, if the Durbin-Watson value is less than 1.5 or greater than 2.5 then there is potentially a serious autocorrelation problem (Gregoire, 2014). Otherwise, if the Durbin-Watson value is between 1.5 and 2.5 then autocorrelation is likely not a cause for concern (Gregoire, 2014). The data met the assumption of independent errors with a Durbin-Watson value of 1.64.

Next, the variance inflation factor (VIF) was assessed. Generally, values close to 10 and above 10 indicate serious multicollinearity in the model, meaning independent predictors have a serious correlation with each other (Green & Salkind, 2014). Tests to see if the data met the assumption of collinearity indicated that multicollinearity was not a concern (Intervention Composite, Tolerance = 0.980, VIF = 1.021; Hospital Size by number of HCP, Tolerance = 0.980, VIF = 1.021).

Cook's Distance was used as a diagnostic tool to measure undue influence; or specific outliers that may have undue influence on the model. Generally, values of 1.0 or greater, are considered problematic (Gregoire, 2014). After examining the Cook's distance (min 0.000; max 0.329), it was assumed there was minimal undue influence on the model. A histogram was also used to analyze the distribution of errors. Another assumption of multiple regression is the normal distribution of errors. The histogram produced an even distribution, which indicated no significant deviation of normality (see Figure2).

Figure 2

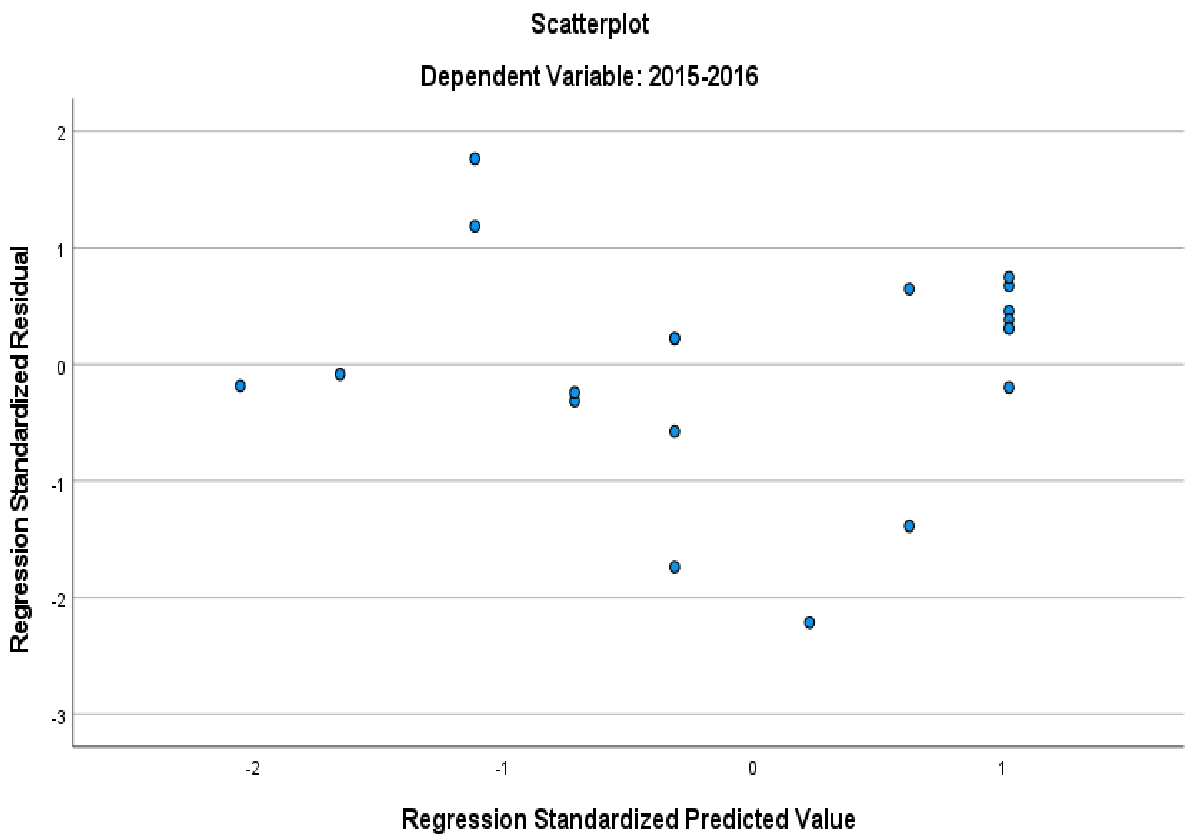
RQ3 Histogram of the Distribution Of Errors



Lastly, a scatterplot was analyzed to measure the assumption of homoscedasticity, or whether the residuals at each level of the predictor were equal in variance. Within the scatter, there was no discernable pattern (see Figure 3). The scatter was also used to assess the assumption of linearity. The scatter depicted evidence of a linear relationship; if not, the scatter may perform a U-shaped pattern (Cohen et al., 2013). The scatterplot of standardized predicted values showed that the data met the assumptions of homogeneity of variance and linearity. Based on the linear regression assumptions, all the rules were met for the analysis.

Figure 3

RQ3 Scatterplot of Residuals and Predicted Values



In summary, a multiple linear regression was calculated to predict the results of the 2015/2016 influenza season vaccination rate based on the strategies interventions composite and hospital size by the number of HCP. A significant regression equation was found, $R^2 = 0.203$, $F(2,17) = 2.159$, p = .146. Hospital administrators predicted the 2015/2016 influenza season vaccination rate is equal to 0.299 (Constant) + 0.088

(Strategies Interventions Composite) + 0.026 (Hospital Size by Number of HCP), where strategies interventions composite measures as effectiveness level between 1 and 5, and hospital size by the number of HCP measures as small, medium, and large. Hospital administrators' 2015/2016 influenza vaccination rate increased 8.8% for each score of the effectiveness level and 2.6% for each hospital size by the number of HCP measures. Both the strategies interventions composite and the hospital size by the number of HCP were not significant predictors of the 2015/2016 influenza season vaccination rate. Without the evidence of a significant association between non-mandate organizational strategies and reported vaccination rates in hospitals affiliated with the AH network, I failed to reject the null hypothesis of RQ3. Table 18 and table 19 display the results from the multiple linear regression test.

Table 18

RQ3 Multiple Linear Regression Model Summary (n=20).

R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. F Change
.450	.203	.109	.1377	.203	2.159	2	17	0.146

Table 19

RQ3 Multiple Linear Regression Coefficients Between the Predictors of 2015/2016 Season (n=20).

Model	Unstandardized Coefficients		Standardized Coefficients	*t*	*p*
	B	*SE*	Beta		
__ (Constant)	.299	.219		1.364	.190

Hospital number of HCP	.026	.042	.136	.623	.541
Strategies Interventions Composite	.088	.047	.410	1.873	.078

Summary

In this chapter, I described the results of my statistical analyses for three research questions. I conducted a paired samples *t* test to investigate the relationship between influenza vaccination rates before and after mandatory reporting. I presented the results of each analysis, summarized the findings, and presented the conclusions for Research Question 1. The results indicated a significant positive relationship of an increase in the influenza vaccination rate after mandatory reporting. I then conducted a repeated measures ANOVA for Research Question 2, using a Greenhouse-Geisser correction test to investigate the differences in influenza vaccination rate for each season. The results showed that the influenza vaccination rate means differed significantly between reported seasons. I also conducted a Pearson coefficient correlation test for Research Question 2 to further investigate the nature of the correlation. The results indicated there was a positive correlation between pre-mandatory reporting seasons and a positive correlation between post-mandatory reporting seasons. However, there was a negative correlation between the seasons pre- and post-mandatory reporting. Finally, I conducted a multiple linear regression to investigate the relationship between the organization strategies composite and the hospital size by the number of HCP as a predictor of the results of influenza vaccination rate for the 2015/2016 season. The results of this test for Research Question 3 indicated there was no relationship between the effectiveness of hospital strategies nor the size of the hospital by the number of HCP with the results of influenza vaccination rate for the 2015/2016 season.

Chapter 5 will include a detailed analysis and interpretation of the results. I will also interpret the findings, recommend future research, and outline the social change implications of this study.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this quantitative study was to evaluate the relationship between mandatory reporting of the influenza vaccination rate and the intake of influenza vaccination rate among HCP in the AH network. By examining this relationship, additional knowledge was gained about the impact of mandatory reporting on vaccination as one of the health care preventative measures for influenza. Data collection evaluated the premandate and postmandate influenza vaccination rates from the 2010/2011 influenza season until 2017/2018. The health care organization consisted of 21 health care facilities; however, only 20 facilities fell under the mandatory reporting. Most of the facilities are in California except for three hospitals located in Oregon and Hawaii.

While mandatory reporting of HCP influenza vaccination rate was recommended by the National Quality Forum (NQF) in May 2012, the Centers for Medicare and Medicaid Services (CMS) required certain health care facilities to report influenza vaccination rates among HCP beginning on January 1, 2013 (for the 2012-2013 influenza season), and October 1, 2014, respectively. Health care facilities reported the first complete season (October to March) in 2014/2015. The data presented in this study included four full seasons before the mandatory reporting requirement (2010/2011, 2011/2012, 2012/2013, 2013/2014) and four complete seasons after the mandatory reporting requirement (2014/2015, 2015/2016, 2016/2017, 2017/2018). The data were collected through a survey sent to hospital administrators in each facility and through a CMS portal called Hospital Compare. The survey asked about the four seasons premandate and the effect of existing strategies employed by each facility and beliefs surrounding the influenza vaccination program for HCP.

After the data were collected, SPSS was used to provide descriptive statistics. A paired samples *t* test was used to analyze Research Question 1 if mandatory reporting impacted the influenza vaccination rate among HCP. The results showed a statistically significant influence of mandatory reporting requirements on HCP influenza vaccination rate, mM = 14%, SD = 0.20, 95% CI [0.046, 0.237], $p < .006$. Bivariate correlation was used to analyze Research Question 2 to test if there is a correlation between different seasons. The results showed that influenza vaccination rate means differed significantly between reported seasons. Linear regression was used to analyze Research Question 3 to examine the impact of other beliefs and strategies and the hospital size by HCP as predictors of the influenza vaccination intake. The strategies interventions composite and the hospital size by the number of HCP were not significant predictors of the 2015/2016 influenza season vaccination rate. In this chapter, I will provide an interpretation of findings for each research question, a review of the theoretical framework, a summary of the study's limitations, recommendations for future research and action, and a discussion of the study's social change implications.

Interpretation of Findings

This study found that mandatory reporting of HCP influenza vaccination rates impacts HCP influenza vaccination rates. The findings confirmed that the HCP influenza vaccination rate improved significantly after mandatory reporting was implemented. Based on the correlation analysis, this study also confirmed that the influenza vaccination rate differed significantly between seasons. However, the study did not find the organization's strategies nor its size (in terms of the number of HCP) as predictors of the vaccination rate after mandatory reporting was implemented.

The result of this study may be aligned with the theoretical foundation of Protection and Motivation Theory (PMT) (Rogers, 1975, 1983). Per PMT, self-efficacy is most strongly correlated with protection motivation. The motivation of healthcare organizations to comply with mandatory reporting and tracking of vaccinations of HCP may be assumed to be associated with a potential threat such as public reporting of the HCP influenza vaccination rate. In the first research question, my goal was to understand the effects of the mandatory reporting of influenza vaccination on the HCP influenza vaccination rate, which is a key to the perceived severity of a threatening event in the PMT. In the second research question, I sought to understand the differences between each influenza season pre-and post-mandate as the perceived probability of the occurrence and efficacy of the recommended preventive behavior under the PMT. The third research question was designed to identify the current predictors of using organizational health promotion strategies to inform the perceived self-efficacy related to the PMT.

Research Question 1

RQ1 was designed to examine the following question: *To what extent, if any, have the influenza immunization rates for HCP employed by the AH network significantly changed since the reporting mandate was introduced in 2012?* I found a positive and significant relationship in the influenza vaccination rate over time among HCP for the 20 health care facilities. The premandate vaccination mean for influenza across all facilities in the 2010/2011 season was 58.7% and increased to 79.2% in the 2017/2018 season. Although this was a positive finding, the Healthy People 2020 goal of a 90.0% HCP influenza vaccination rate for HCP was not achieved (Healthy People, 2013).

Since 2003, health care organizations have become more diligent with establishing voluntary influenza vaccination programs for their employees (Healthy People, 2013). Although the vaccination rate has increased seven-fold within the past 25 years, it remains lower than the Healthy People 2020 goal of 90% vaccination coverage among HCP (Healthy People, 2013). Federal programs, policies, regulations, and laws must be consistent with achieving this goal (Healthy People, 2013; Riphagen-Dalhuisen et al., 2012).

In a study conducted before the mandatory reporting requirement, the influenza vaccination rate for the ten years between 1997 and 2007 increased from 45.0% in 1997 to 72.0% in 2007 (Ajenjo et al., 2010). Another study examined the vaccination rate in the pre-mandate era for three consecutive years. The vaccination rate increased from 16.0% in 2001/2002 to 40.0% in the 2003/2004 season by improving influenza vaccination availability to HCP (de Juanes et al., 2007). The more available and convenient vaccination is made for HCP, the higher the compliance and intake. Between 2000 and 2002, the use of a mobile cart was examined as a possible strategy to enhance access to the influenza vaccination program (NVAC, 2013; Sartor et al., 2004). The authors estimated that vaccination intake increased from 6.0% in 1998 to 32.0% in 2002 due to the availability of the vaccine through the mobile cart. While vaccine availability led to an increase in the HCP influenza vaccination rate, the implementation of mandatory vaccination by the University Hospital System was found to increase over five-fold in five years.

In a study that showed a more drastic improvement before the mandatory reporting, Barnes-Jewish Healthcare achieved improvement from 45% to 98.4% influenza vaccination rate by introducing a compulsory vaccination program (Babcock et al., 2010). Correspondingly, Virginia Mason Medical Center reached and maintained for five years before mandatory reporting requirement a 98.0% influenza vaccination rate by making influenza vaccination a requirement for employment (Rakita et al., 2010).

In summary, the mandatory reporting relationship examined in RQ1 asserted a positive impact on the HCP influenza vaccination rate. However, the significant increase in the rate was insufficient to achieve the Health People 2020 goal of a 90.0% HCP influenza vaccination rate. Consistent with past research before mandatory reporting, a multifaceted approach to HCP influenza vaccination intake with an emphasis on mandatory vaccination as a condition of employment assures reaching and maintaining over 90% influenza vaccination rate among HCP (Babcock et al., 2010; Rakita et al., 2010).

Research Question 2

RQ2 was designed to examine the following question: *Are reported influenza vaccination rates comparable between hospitals affiliated with the AH network?* Each season's influenza vaccination rate was examined and compared to the prior year's rate from 2011/2012 through 2017/2018 seasons. With exception of 2013/2014 season, there was a significant positive correlation between 2010/2011 and 2011/2012 seasons (*r* = 0.995, *p* = .000), 2011/2012 and 2012/2013 seasons (*r* = 0.971, *p* = .000), 2012/2013 and 2013/2014 seasons (*r* = 0.851, *p* = .000), 2014/2015 and 2015/2016 seasons (*r* = 0.902, *p* = .000), 2015/2016 and 2016/2017 seasons (*r* = 0.575, *p* = .004), and 2016/2017 and 2017/2018 seasons (*r* = 0.848, *p* = .000). However, the 2010/2011 season was negatively and significantly correlated with the 2017/2018 season *(r* = -0.552*, p* = .006*)*. I concluded that the mandatory reporting of HCP influenza vaccination rate contributed to the increase of vaccination rate

The PMT proposes that people protect themselves based on four factors, including (1) perceived severity of a threatening event, (2) perceived probability of the occurrence, (3) efficacy of the recommended preventive behavior, and (4) perceived self-efficacy (Rogers, 1975, 1983). The model can explain why people engage in unhealthy practices and suggest why they might change those behaviors.

Research suggests that among the factors (vulnerability, severity, rewards, response efficacy, self-efficacy, and costs), self-efficacy is the most strongly correlated with protection motivation (Rogers, 1975, 1983). PMT has been applied in many different personal health contexts including cancer prevention, diet, and exercise, healthy lifestyle, smoking, AIDS prevention, alcohol consumption, and adherence to medical treatment (Floyd et al., 2000; Milne et al., 2000).

The theory has been used to examine the ability of individuals to implement different preventative measures to protect themselves from a threat (Stroebe, 2011). Thus, the protection motivation concept applies to any health threats impacted by individuals or organizations' health recommendations (Floyd et al., 2000).

The motivation to comply with mandatory reporting and tracking of vaccinations of hospital personnel may be assumed to be associated with a potential threat. The threat to the health network in the situation of mandatory reporting of influenza vaccine is the public visibility of vaccination intake. However, the coping appraisal aligns with potentially enhanced self-efficacy among HCP. Both PMT factors of coping and self-efficacy may lead hospitals to protection motivation by addressing the mandatory public reporting compliance or vaccination intake depending on HCP.

Research Question 3

RQ3 was designed to examine the following question: *are vaccination rates associated with organizational strategies other than the 2012 reporting mandate?* Hospital administrators were asked how effective they believed the hospitals' strategies (free influenza vaccine, HCP education, establishing a culture of prevention, maintaining knowledge with up-to-date guidelines, and incentivizing HCP through wellness programs) were at increasing the HCP influenza vaccination rate. The highest-rated strategy was providing a free influenza vaccine (70.0%). However, in a multiple regression analysis to examine the composite of the organization strategies and hospital size (number of HCP) as predictors of the influenza vaccine rate, the effectiveness of the strategies contributed only to 8.8% of the vaccination rate; these results were not statistically significant.

As described in chapter 2, a multifaceted approach as a strategy to enhance influenza vaccine uptake among HCP may include the use of the declination form, providing free vaccination, communication of vaccination availability through hospital-wide announcements, prospective auditing, and phone interviews with HCP who did not receive a vaccination (Honda et al., 2013). Their study results indicated a multifaceted approach enhanced influenza vaccination rate to 97.0% in the 2012-2013 influenza season (Honda et al., 2013).

In summary, RQ3 results demonstrated the effectiveness of the organization's strategies and its size did not strongly predict HCP influenza vaccination rate. This knowledge could enhance future program development and add to the organization's understanding of the effectiveness of the implemented strategies to encourage vaccination.

Limitations of the Study

There are several limitations to the present research that could be addressed in future research. Because hospitals were not randomly assigned to receive the vaccine reporting mandate, it is impossible to speak to a causal link between the mandate and higher vaccination rates following its introductions. Because there were no data for vaccination rates before 2010-2011, it was also difficult to say whether vaccination rates were lower every year before the introduction of the mandate or whether vaccination rates have constantly fluctuated.

Another limitation was how hospitals within this health care network collected data before the mandate. There was no defined process or definition on how the rate was collected and calculated before the mandate. However, the reporting mandate established a more defined approach to calculate vaccination rates.

Another limitation of this study was the sample size. The AH network in this study represented a small fraction of the total hospitals in the United States. Thus, the results may not be applicable across health care networks.

Recommendations for Future Research

This study began before the COVID-19 pandemic and enhanced the understanding of mandatory reporting of the HCP influenza vaccination rate. On August 5, 2021, the California Department of Public Health Officer ordered all HCP in the state to receive full COVID-19 vaccination doses, including the booster (Infectious Disease Alert Updates, 2021). The order came after the increase in cases and as many as 9,300 outbreaks of COVID-19 across the state. Influenza and COVID-19 are alike in causing pandemics worldwide (Roman et al., 2021). Thus, future research is needed to examine mandatory HCP vaccination requirements' impact on the transmission and prevention of infectious diseases. The downstream consequences of a vaccination reporting mandate were beneficial to understanding vaccine intake. Future research could examine whether hospitals with higher vaccination rates have better outcomes, such as lower infection rates or lower re-admission rates for patients.

Regarding whether there is variability in vaccination rates between hospitals, future research could look at the variabilities in vaccination rates within hospitals. In other words, rather than looking at just average vaccination rates at the hospital level, it would be beneficial to examine variability in vaccination rates among HCP within hospitals. Researchers could look at whether there are essential differences in vaccination rates between different groups such as doctors and nurses or other types of physicians. Studies could also explore how and when people in hospitals get vaccinated. This additional information could clarify whether interventions are needed to improve vaccination rates, focusing on who needs to be targeted and when.

Regarding whether vaccination rates are associated with other organizational strategies to improve health outcomes, future research should examine different strategies besides the three explored in this data. In terms of data collection, it may be beneficial to measure other strategies with a more continuous measure than the binary yes/no used in this study. For example, participants could report how frequently a strategy is implemented in their hospital and how HCP adhere to the strategy. An increase in the variability of responses would enhance the organization's knowledge about the vaccination rates related to the organization's strategies. Furthermore, it would be essential to examine the direction and strength of such relationships – for example, does having one strategy make it more or less likely that another strategy is implemented? If other organizational strategies to improve health cannot be measured, future research should at least measure HCP perceptions of whether different strategies are being utilized in their hospital – and if so, how effectively.

Implications for Social Change

Influenza is preventable since there is a seasonal influenza vaccine that deters infection (CDC, 2013c). A vaccination intake goal among HCP was established by the Healthy People 2020 initiative (National Vaccine Advisory Committee, 2013). To support this goal, the Centers for Medicare & Medicaid Services (CMS) adopted the mandatory reporting measure as one of the Inpatient Quality Reporting Program through the Center for Disease Control and Prevention (CDC, 2012a).

Mandatory vaccination reporting policy has been debated nationally and internationally (Rosenbaum, 2012). While vaccination is believed to be a tool in disease prevention, the influenza vaccination intake among HCP involves broader social, behavioral, and ethical aspects (Rosenbaum, 2012). Hence, positive change that reduces the economic burden of influenza-related outbreaks relies on multiple issues. The impact of mandatory reporting of HCP influenza vaccination rates was the focus of this study. Results from this study can provide support to health care policymakers and stakeholders on health care strategies related to disease transmission and prevention.

Individual

Although the current study focused on one specific organization implication, some of the findings can be applied at the individual level. The results showed that PMT, the theoretical foundation of this study, could apply to HCP in the workplace and part of the community. The PMT suggests that individuals ensure themselves dependent on four variables (1) perceived the severity of a threatening event, (2) perceived probability of the occurrence, (3) efficacy of the recommended preventive behavior, and (4) perceived self-efficacy. The model can clarify why individuals participate in undesirable practices and propose thoughts for changing those practices (Rogers, 1975, 1983). Medical organizations could apply these findings to improve wellness programs for their workers. If HCP embrace positive wellbeing practices like flu immunization their organization might become better, more practical, and eventually more affordable in giving medical care.

Organizational

The organizational implications of these results could be significant. If the organization can recognize the direct and indirect cost of preventative strategies as discussed in the result of Research Question 3, it may unlock the potential cost saving of a unified strategy that will work across the hospitals. For example, if the organization focused more on delivering an effective free influenza vaccine, it may effectively promote its intake. In consolidating these outcomes, I recommend developing the business case for putting resources into the wellbeing of HCP. With a rising need to enhance engagement in health care, additional resources should be given to ensure a healthier lifestyle that supports HCP in the workplace.

Societal and Policy

The present study may positively impact policymakers developing public health mandates from the societal and policy perspective. Mandatory reporting as a policy improved the vaccine intake among HCP in the AH network. The overall health of the society may improve through focusing on preventative measures to improve the health and wellbeing of HCP. For more impactful policy, recommendations may include further improving the vaccine efficacy, using social media to promote vaccination, incentivizing vaccination, and balancing public health protection through a combination of mandate and promotion.

Conclusion

This study began with a complex examination of the lack of vaccination among HCP. Data was collected from a health care network with 20 hospitals and the influenza vaccination rate was examined. The analysis focused on the four consecutive seasons before the influenza vaccination rate mandatory reporting and the four consecutive seasons after mandatory reporting was implemented. The study was designed to gain additional insight into the relationship between mandatory reporting and vaccination intake. Mandates and various organizational strategies needed to be formally evaluated. Therefore, the basis of this study was an assessment of the relationship between vaccination rate trends and the 2012 mandate. Hospital non-legislative strategies to maximize vaccination rates were also considered by surveying hospital administrators working in each hospital.

After I presented the study's goals and design, the Walden IRB and the organization IRB approved the research proposal. The research method was a quantitative retrospective cohort study design using secondary data available through CMS Hospital Compare and primary data collected through the survey. The data analysis used three distinct methods: a paired samples *t* test, bivariate correlation analyses, and linear regression. SPSS was used for descriptive analysis and data analysis. From this point, the research questions were analyzed, and the results were examined to provide more insight into examining the hypotheses.

The findings suggest it is possible that the reporting mandate did have a positive effect on HCP influenza vaccination rates after it was introduced. There was a significant increase in the average influenza vaccination rates across all hospitals from the years before the mandate (2010-2013) to the years after (2014-2018).. The findings also showed that if the mandate did have the desired impact, it did not get the organization to the HP 2020 goal of 90.0%. Secondly, the findings did show evidence of a relationship between the grouped pre-mandate seasons and the grouped post-mandate seasons. Finally, the findings also showed that the organization's strategies and size were not predictors of the influenza vaccination rate among HCP.

The implications of this study became apparent through the influenza vaccine rate changes before and after the implementation of mandatory reporting, which shows the impact of legislation. This study was the first to show that while mandatory reporting enhances the vaccination rates, it may fall short in delivering target goals. Health care organizations believe in investing in HCP as they are one of their greatest assets to provide care to patients. Recommendations for future studies are to examine further the organizational strategies and different health care policies' roles in improving the health of HCP.

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Appendix A: Definitions

Healthcare Personnel (HCP): All medical and non-medical employees with direct contact with patients or providing any level of patient care or administration. The entire population of healthcare workers in any healthcare settings, which might include both clinical and non-clinical employees, volunteers, and contractors regardless of clinical responsibility or patient contact (CDC, 2017).

Mandatory Healthcare Personnel Safety Reporting Plan: The required reporting for hospital healthcare facilities receiving patients from the center of Medicare and Medicaid to report vaccination rate to the NHSN (CDC, 2017).

National Healthcare Safety Network (NHSN): A reporting system for Healthcare Organizations is functioning under the CDC (CDC, 2017).

Vaccination Compliance Rate: The total number of HCP who received influenza vaccination at this healthcare facility to the total number of HCP who provided a written report or documentation of influenza vaccination outside this healthcare facility since influenza vaccine became available this season divided by the total number of HCP who were working at the healthcare facility between October 1 and March 31 (CDC, 2017).

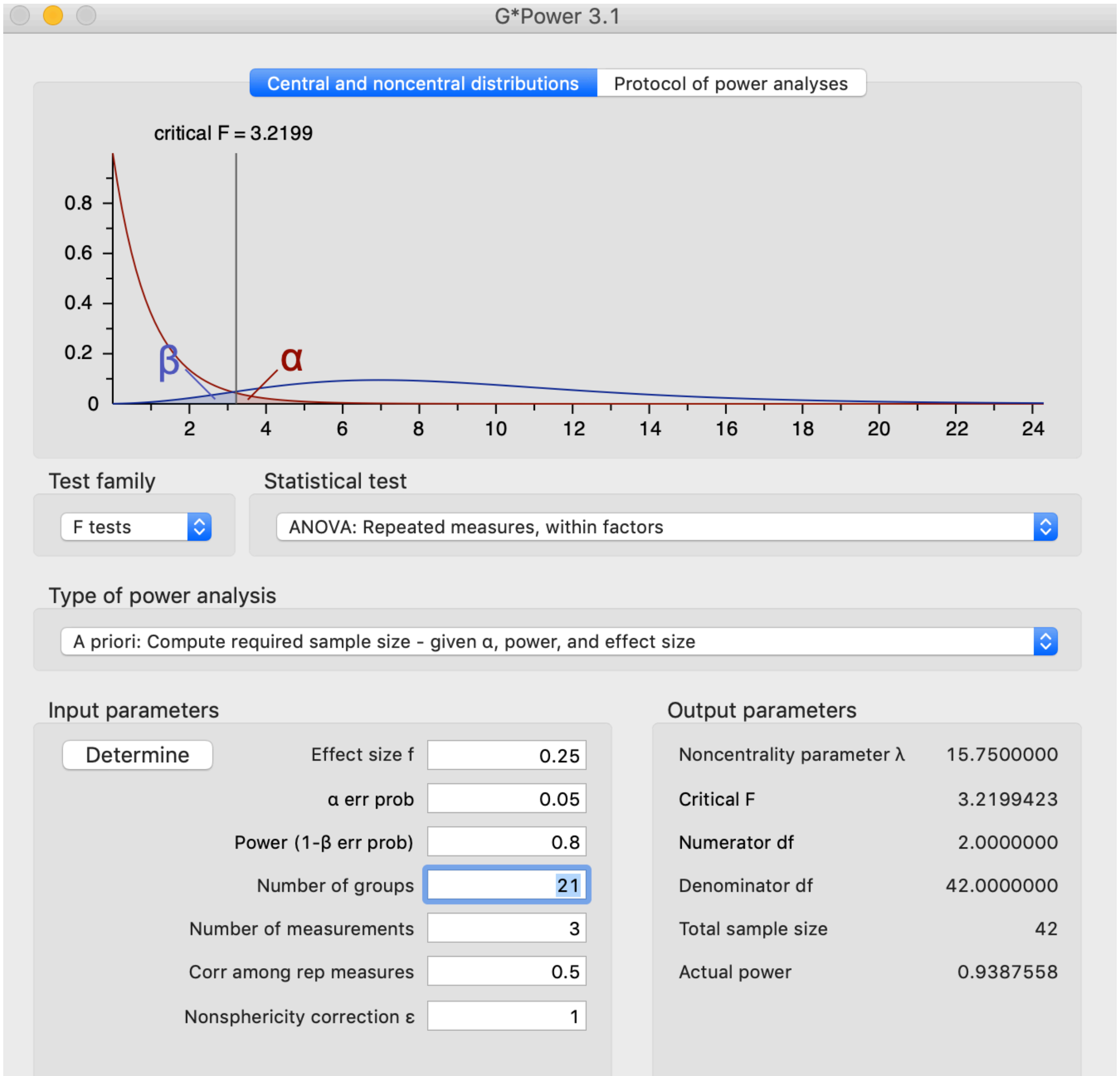
Vaccination Rate: The total number of vaccinated HCP/the total number of HCP presented as a percentage of vaccination.

Healthcare Personnel Influenza Vaccination Measure: The reported influenza vaccination measure starts October 1 through March 31 (CDC, 2017).

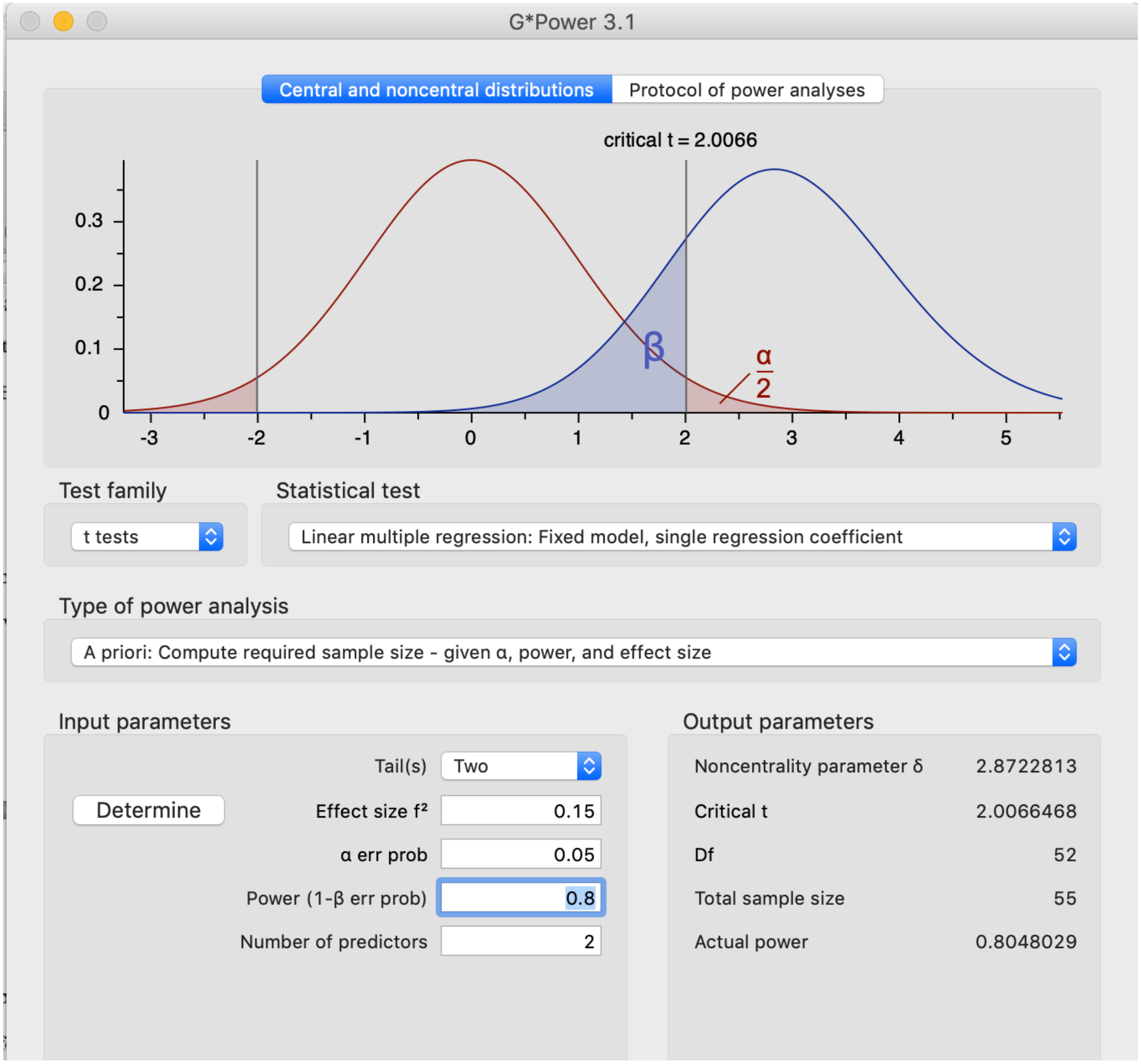
Vaccination Seasonal Influenza vaccine: Vaccination definition in this study means the seasonal influenza vaccination. A vaccine for seasonal influenza virus offered on an annual basis (CDC, 2017).

Appendix B: G*Power Sample Size Computation Using Paired Samples *t* test

Appendix C: G*Power Sample Size Computation Using Repeated Measures ANOVA



Appendix D: G*Power Sample Size Computation Using Multiple Linear Regression



Appendix E: Influenza Immunization Questionnaire

1. Which hospital do you represent?

- ☐ **Adventist Health Bakersfield**
- ☐ **Adventist Health Castle**
- ☐ **Adventist Health Clearlake**
- ☐ **Adventist Health Feather River**
- ☐ **Adventist Health Glendale**
- ☐ **Adventist Health Hanford**
- ☐ **Adventist Health Howard Memorial**
- ☐ **Adventist Health Lodi Memorial**
- ☐ **Adventist Health-Portland**
- ☐ **Adventist Health Reedley**
- ☐ **Adventist Health Rideout**
- ☐ **Adventist Health Selma**
- ☐ **Adventist Health Simi Valley**
- ☐ **Adventist Health Sonora**
- ☐ **Adventist Health St Helena**
- ☐ **Adventist Health Tehachapi Valley**
- ☐ **Adventist Health Tillamook**
- ☐ **Adventist Health Ukiah Valley**
- ☐ **Adventist Health Vallejo**
- ☐ **Adventist Health White Memorial**

 Tulare Regional Medical Center

2. Please complete the following:

   a) HCP Vaccination rate for 2010/2011: %

   b) HCP Vaccination rate for 2011/2012: %

   c) HCP Vaccination rate for 2012/2013: %

   d) HCP Vaccination rate for 2013/2014: %

3. Are any of the following strategies required at your hospital?

   Influenza immunization as a condition of employment Yes No

   Influenza Vaccine Declination Statement from those who decline Yes No

   Education Session on Influenza Transmission Yes No

4. How effective (1 - very ineffective, 2 - somewhat ineffective, 3 - neither effective or ineffective, 4 - somewhat effective, and 5 - very effective) do you feel the reporting mandate is for increasing the influenza immunizations of healthcare workers at:

    Your Particular Hospital

    Adventist Health Network

    All Hospitals & Health Facilities

5. Please rate how effective (1 - very ineffective, 2 - somewhat ineffective, 3 - neither effective or ineffective, 4 - somewhat effective, and 5 - very effective) you

think the following are for preventing the spread of influenza in the hospital environment:

- Influenza vaccine
- Covering mouth with a mask
- Using a mask only once
- Using gloves only once
- Washing gloves/masks after use

6. Does your facility require healthcare personnel who refuse influenza vaccination to wear a mask or other personal protective equipment (PPE)?

□ Yes

□ No

If yes, state the start year_________

7. How effective (1 - very ineffective, 2 - somewhat ineffective, 3 - neither effective or ineffective, 4 - somewhat effective, and 5 - very effective) are the following:

- Provide free vaccine at the workplace
- Provide a robust educational program for staff.
- Establish a culture of prevention
- Maintaining up to date knowledge with the guidelines
- Incentivize staff through a wellness program

8. Are you on track to achieve a 90% vaccination rate by 2020? □ Yes □ No□ Unsure

9. What strategy might hospitals consider to maximize personnel immunization rates?