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Impact of Hospital Inventory Management of PPE on State-Level Healthcare Worker Infections during the COVID-19 Pandemic

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Biography

Nidhal Bouazizi is a doctoral student at DePaul University. He is a part of their Doctor of Business Administration program. He is a lecturer at DePaul University and enjoys teaching operations management to more than 60 students each term. In addition, he will be starting a full-time position at Lewis University in the fall of 2022, as an Assistant Professor of Business Analytics.

Outside of the classroom, Nidhal enjoys spending time with his children, cooking, watching soccer, and going on long car rides with his wife.

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Abstract

The COVID-19 pandemic has put a spotlight on the personal protective equipment (PPE) supply chain and its inability to keep up with the fluctuating demands of a global pandemic. Limited research examines the resilience of the PPE supply chain in times of stress, and very few studies rely on quantitative retrospective analysis. This dissertation studies the impact of hospital inventory management, a portion of PPE supply chain preparedness, on infections in healthcare workers (HCWs). Our research shows that there exists a statistically significant negative relationship between PPE preparedness and infections for HCWs, but this relationship is only significant for N95 masks, surgical masks, and gloves. This suggests the importance of hospital inventory management of PPE in the prevention of infections for HCWs is not equal for all types of PPE and in times of stress, practitioners may be able to focus on the elements of PPE that prevent infection.

Keywords: Personal Protective Equipment (PPE), hospital inventory management, supply chain preparedness, healthcare worker, COVID-19 Pandemic

Chapter 1

Introduction

Personal protective equipment (PPE) has become a highly discussed topic since the beginning of the COVID-19 pandemic in 2020 as hospitals struggle to maintain an adequate supply of PPE to keep healthcare personnel safe and able to continue treating patients. In the first few months of the COVID-19 pandemic, supply shortages of medical PPE began to display across every news outlet and media source (National, 2021). It became clear that the United States and the rest of the world were not prepared for a disaster of this capacity and the PPE supply chain was not going to be adequate to meet the demand. According to some researchers, the shortages in protective equipment were predictable and preventable (Dai et al., 2020). Yet there is little research that demonstrates how changes in the supply chain at the level of hospital inventory management could make substantial differences in PPE supply during a crisis such as the COVID-19 pandemic due to major flaws in the PPE supply chain that can now be easily identified in retrospect (National, 2021).

PPE is utilized in hospitals and healthcare settings to limit the transmission of illness or infection to healthcare workers and between other individuals in contact with the workers (Health, 2020). The PPE supply chain is not often studied in the literature outside of times of major volumes of utilization, but the resilience of the PPE supply chain has been called into question multiple times in the recent past due to major lapses in the supply chain being able to keep up with demand (National, 2021). Resilience in supply chains is broken down into preparedness, response, and recovery/growth (Mousavi, 2017). Preparedness is the ability of a supply chain to be fully prepared for a potential disruption in the supply chain. Response is the ability to have an adequate reaction to a disturbance. Recovery/growth is the ability to return to the previous state before the disturbance or potentially create a new steady state for preparedness for future disruption (Mousavi, 2017). PPE supply chain resilience is contingent upon the ability of all components of the supply chain to keep up with growing demands and fluctuating circumstances affecting supply.

There exists little research regarding the resilience of PPE supply chains, and even less research is available examining the resilience of supply chains during unprecedented global pandemics, such as the COVID-19 pandemic. Some entities began researching the best methods for reusing single-use items, such as N95 respirators (Bernard et al., 2020). But some states were faring better despite low supply compared to other states. Recently, the United States Public Health Emergency sector of the Department of Health and Human Services created a document entitled, "*National Strategy for a Resilient Public Health Supply Chain*," which details the government's current assessment of the public health supply chain and some goals for future public health emergencies. But even the United States government was unable to rely heavily on quantitative analyses and based its decisions on expert testimony and qualitative reports. PPE supply chain resilience has multiple phases, but this research focuses on the preparedness of supply chains to be challenged by stressors to the supply chain such as a global pandemic. Response and recovery cannot yet be studied, as the pandemic remains ongoing in the US and these measures are best studied after the resolution of a stressor to the supply chain.

Given that the pandemic remains ongoing and there is publicly available data regarding PPE supply which allows for examination of PPE supply chain preparedness, we can address PPE supply chain preparedness questions in this research through the following questions: Why do some states maintain lower infection rates among healthcare workers? Do states with more prepared PPE supply chains maintain lower infection rates among healthcare workers (HCWs) compared to states with less prepared PPE supply chains? What is the role of supply chain preparedness in the state-level infection rates in HCWs?

In this dissertation, we address these questions by studying if states with better-prepared PPE supply chains are more likely to have fewer total case numbers of infections in HCWs than those with less-prepared PPE supply chains. To that purpose, we define the metrics that determine supply chain preparedness, conduct an in-depth analysis of the supply chain preparedness of states in the United States during the pandemic, and determine if a relationship exists between the PPE supply chain preparedness and the infection of HCWs. Our specific aims are as follows:

Aim 1: Define measures of PPE supply chain preparedness. Through this aim, we identify the current research on supply chains and review the existing definitions of supply chain resilience, focusing on the components of preparedness. We then formulate an operational definition of hospital inventory preparedness as a subcomponent of PPE supply chain preparedness as the core of this research.

Aim 2: Compare PPE supply chain preparedness in different states in the United States. In this step, we apply the definitions from Aim 1 to the data gathered and quantitatively analyze the preparedness of PPE supply chains during the pandemic.

Aim 3: Identify if a relationship exists between PPE supply chain preparedness and the level of infections in HCWs in the United States. In Aim 3, we determine if a relationship exists between preparedness studied in Aim 2 is quantitatively related to the infection rates in HCWs.

Aim 4: Provide hospital inventory management recommendations to prepare efficiently during a novel virus pandemic. Finally, we incorporate the lessons learned from the previous steps to make recommendations to stakeholders in healthcare supply chains to improve preparedness for future stresses on the supply chain.

This research provides insights as follows: 1) PPE hospital inventory preparedness decreases the overall number of infections in HCWs and 2) this finding was not unanimous for all PPE types. Specifically, the preparedness of N95 masks, surgical masks, and gloves showed a negative relationship with HCWs infections, which may help practitioners prioritize the PPE supply of these items over ones that do not impact HCWs infections in times of stress to PPE hospital inventory and supply chain.

This research fills the gap in the literature relating to the impact of the PPE supply chain and hospital inventory preparedness on healthcare worker infections. We utilize the publicly available databases from the current pandemic to evaluate the preparedness of PPE hospital inventory management in each state, including surgical masks, N95 respirators, gloves, gowns, and face shields, and how PPE supply chain preparedness impacts the infection rates in HCWs. In Chapter 2, we review the current literature and develop our hypotheses. Chapter 3 presents the methods of the research, including introducing the empirical model. Chapter 4 details the findings of the analyses. Chapter 5 discusses the research's implications, our study's potential limitations, conclusions, and future directions.

Chapter 2

Literature Review and Hypothesis Development

Background

Three main streams of literature are related to our research study – supply chain resilience, PPE supply chain resilience during other crises, and PPE supply chain during the COVID-19 pandemic. This literature review also touches on the role of transmissibility of COVID-19 and what is known about hospital inventory management of PPE.

The definition of supply chain resilience has taken many forms. Tukamuhabwa, Stevenson, Busby, and Zorzini (2015) expanded on the existing definition of supply chain resilience to create their definition that included preparation, response, recovery, and growth. The researchers conducted a thorough review of the literature and identified multiple large gaps in the literature that need to be answered by future researchers, including strategies for improving supply chain resilience and longitudinal studies of supply chain resilience and threats to supply chain resilience in specific fields. Chowdhury and Quaddas (2016) attempted to fill the existing gap in the literature by utilizing a large survey to achieve two main goals. First, the survey results validated existing dimensions in the literature. Second, the validated measures were used to create a novel, hierarchical model measuring resilience in terms of readiness, response, and recovery and the main factors influencing the model were supply chain readiness capability and response-recovery capability. Pires Ribeiro and Barbosa-Povoa (2018) expanded on the existing models by incorporating both cost and time into the measurement of recovery of operations (Pires & Barbosa-Povoa, 2018).

Delving into the second gap identified by Tukamuhabwa et al. (2015), Mousavi et al. (2017) attempt to incorporate the model of preparedness, response, and recovery and growth into their research by expanding upon sub-elements of these phases of supply chain resilience into domains that apply to healthcare supply chains, such as contract flexibility in preparedness, risk sharing in response, and partnership in recovery and growth. These sub-elements allow for easier study of supply chain resilience in healthcare. Getele, Li, and Arrive (2019) give a real-world application of Mousavi's argument when they examined the role of social ties, institutional support, and interagency relationships in the healthcare service supply chain by evaluating the Ethiopian healthcare system. They found that collaboration between agencies positively impacted risk mitigation within the supply network. Additionally, they found that when information was diffused throughout the supply network, there was an improved avoidance of disaster and endemic situations (Getele et al., 2019).

Little research has been conducted on the PPE supply chain during times of crisis on the supply chain. Examples of these crises include the outbreak of the Ebola virus in 2014 and the H1N1 influenza outbreak in 2009. The existing literature that reviews the impact of emergent situations on medical supply chains is fragmented, which limits the ability of the managers of supply chains to respond in an informed manner at the time of crisis (Dasaklis, Pappis, & Rachaniotis, 2012). Much of the existing papers on the topic of PPE supply chains during disasters rely on commentary. Patel et al. (2017) reviewed previous public health emergencies and found that much of the focus of preparedness for outbreaks has been on products such as drugs, vaccines, devices, and diagnostic tools and little focus has been put on supplies and their manufacturing and distribution. The authors suggested solutions including tracking PPE supplies and distributions, sharing information across public and private sectors, establishing best practices for use in the use of PPE, and standardizing guidance for state responses to public health emergencies (Patel, D'Alessandro, Ireland, Burel, Wencil, & Rasmussen, 2017), but it does not seem that there has been the application of these findings in current emergency preparedness.

When the first cases of SARS-CoV2 appeared in China in December 2019, it took only a few short weeks to realize that the supply of PPE was not going to be adequate to fulfill the demand needed across the United States. Authors Dallas et al (2021) looked at global value chains (GVCs) for PPE during the pandemic in China, Europe, the United States, and Malaysia, as well as the role of states in influencing the GVCs, finding that states were dependent on the geographical scope and the technological sophistication of their existing GVCs to maintain their supplies with mixed outcomes. Since the pandemic was well controlled in China by early 2020, countries like the United States were able to rely on China for exports to offset the supply burden (Dallas, Homer, & Li, 2021).

Francis (2020) believes that there are factors that should be considered when preparing for a pandemic, such as developing continuity plans and communication plans for the continuity plans, increasing the number of suppliers and the capacity within the supply chains, and developing stronger strategies for sourcing PPE (Francis, 2020), but Pecchia et al. (2020) looked at the chaos that ensued after the shortages in PPE supply began to hit healthcare centers around the world and its lack of overall regulation and standards and reflected on the lack of policy and framework to combat these issues. The chaos they were looking at included individuals with a "do-it-yourself" approach to PPE and companies completely overhauling their operations to create products that they did not create before. These actions were unregulated by policy and regulations. Traditionally, items like surgical masks, N95 respirators, ventilators, and other medical equipment are given certification and approval of manufacture before they are utilized in the healthcare setting, or by the public, but all of this fell to the wayside with the pandemic. These authors suggest that a standard set of tests be generated that the product must pass to enter the market (Pecchia, Piaggio, Maccaro, Formisano, & Iadanza, 2020). This type of regulation and implementation would be essential to preventing products that do not meet quality standards from being used and potentially causing harm to the public, patients, and HCWs.

Information about hospital inventory management of PPE

To balance the cost of storage and buying the appropriate amount of supply to maintain safety for the employees, hospitals need to have a very carefully balanced inventory management system (Abedrabboh, Pilz, Al-Fagih, Al-Fagih, Nebel, & Al-Fagih, 2021). While there are many approaches to this, in times of crisis, a just-in-time approach is not going to be effective for maintaining supply when the demand and supply are always in flux (Balkhi, Alshahrani, & Khan, 2022). Months into the COVID-19 pandemic, the Department of Health and Human Services Administration for Strategic Preparedness and Response came out with a guide for hospital operations with recommendations for where to get information about the amount of PPE supply to maintain in-house, resources for where to obtain additional supplies (TRACIE, 2020).

Transmission of COVID-19

The mode of transmission of COVID-19 was the subject of a great deal of debate in the scientific community as the pandemic raged on in the United States and around the globe. In general, coronaviruses including COVID-19 are transmitted primarily via respiratory droplets that are spread through the air with talking or coughing and contact with contaminated surfaces (Zhou, Ayeh, Chidambaram, & Karakousis, 2021). Standard contact and droplet precautions include the use of a surgical mask, eye protection, gown, and gloves in addition to proper hand hygiene (WHO, 2020). COVID-19 is known to also be able to be transmitted via aerosolized particles and N95 masks were added to the recommended PPE for those coming into contact with patient's infected with or suspected infected with COVID-19 (Zhou et al., 2021). There is not much additional information on recommendations for PPE hospital inventory management, which adds to the growing need for filling the gap in this literature.

Hypothesis Development

Since there has been limited research on PPE supply chain preparedness and hospital inventory management, little is known about how deficiencies in the preparedness of supply chains have downstream effects on the effectiveness of illness prevention in healthcare workers. Based on what is known about the lack of hospital PPE supply and the basic understanding of the transmission of the Sars-CoV-2, it is easy to follow that when there is inadequate supply, healthcare providers must continue treating patients in the same manner as previously, creating potential harm to themselves and further exposure to infectious diseases. We hypothesize that if hospitals are not supplied with PPE, there will be higher rates of infection in HCWs. Hence, we state the following hypotheses to test the relationship between PPE preparedness and infection rates in the healthcare worker population. We hypothesize a negative relationship between PPE preparedness and infection rates among HCWs. This would imply that when there are lower rates of PPE preparedness, higher incidences of infection among HCWs. When the relationship between PPE preparedness and HCWs infections is controlled by other factors that may influence the relationship, it is hypothesized that the relationship between PPE preparedness and HCWs infections remains statistically significant.

Hypothesis 1: There is a negative relationship between hospital inventory PPE preparedness and HCWs infections.

Hypothesis 1a: There is a negative relationship between N95 mask preparedness and HCWs infections.

Hypothesis 1b: There is a negative relationship between surgical mask preparedness and HCWs infections.

Hypothesis 1c: There is a negative relationship between surgical gown preparedness and HCWs infections.

Hypothesis 1d: There is a negative relationship between glove preparedness and HCWs infections.

Hypothesis 1e: There is a negative relationship between eye protection preparedness and HCWs infections.

Chapter 3

Methods

Research Setting

This research is based in the United States and involves each of the 50 states and Washington D.C. and Puerto Rico. Cases obtained through the CDC "Restricted Access Dataset" include HCWs and the general population. Publicly available data on PPE supply for the states in the United States as well as COVID-19 infections are utilized throughout the duration of this project. The duration of the study encompasses 30 weeks from January 2021 to August 2021, as this is the date range available on the hospital-reported supply of PPE. PPE supply measures are obtained from the United States Department of Health and Human Services document, "Combined State Profile Report."

Dependent Variables

Infection of Healthcare Workers. Infections of HCWs per state are measured by the number of cases reported to the CDC (Centers for Disease Control) as being an infection of healthcare workers. The question reported to the CDC had responses of "yes," "no," "unknown," "N/A," and "missing." Only cases with a response of "yes" are considered healthcare worker infections. All other cases are considered to represent infections in the general population. After initial analyses, healthcare worker deaths are excluded from final analyses due to inconsistencies in reporting deaths to the CDC. This is divided by state and distinguished from cases reported in the general population. The raw number of infections in healthcare workers is standardized utilizing the Bureau of Labor Statistics 2019 summary of hospital employees in the public and private sectors.

Independent and Control Variables

PPE Supply Chain Preparedness. For the sake of this research, PPE supply chain resilience is broken down into preparedness, response, and recovery. Response and recovery are unable to be measured until the completion of the pandemic and given that the pandemic is ongoing, the current research focuses on preparedness and response. Preparedness is defined as the percentage of hospitals with 2 or more weeks of supply remaining in their facility, by state. Unprepared is considered in states where hospitals have less than 1 week of supply of PPE remaining. PPE supply chain preparedness is measured by the reported estimated number of days of supply remaining, by type, reported to HHS. This includes measures of remaining N95 masks, surgical masks, surgical gowns, gloves, and eye protection.

Control Variables. Cases reported to the CDC are standardized utilizing the state population reported to the Census Bureau and expressed as the number of infections per 100,000 individuals in the population. Gender, age, race, and other demographic information also serve as control variables for this research which were obtained based on the cases reported to the CDC. Infections in the general population are measured as the number of HCWs infections subtracted from the total number of infections. This is divided by state and distinguished from cases reported in the general population. The general population infection rates are standardized by taking the number in the state population as reported in the 2020 census and subtracting the number of healthcare worker infections as obtained as described above. The total population is considered all the cases reported to the CDC regardless of healthcare worker status. A summary of the variable definitions utilized in this study can be found in Table 1.

Empirical Models

The goals of this research can be summarized in the following empirical model.

$$Y = \beta_0 + \beta_1 x + \beta_2 z$$

Where Y = infection of HCWs. $\beta_1 X$ represents the component of the relationship with infections contributed by the independent variable of preparedness. $\beta_2 Z$ represents the component of the relationship contributed by the control variables of the percent white individuals infected, percentage by gender, and the average age of infected individuals.

Procedures

Data Extraction. The United States Department of Health and Human Services has published data titled "Combined State Profile Report," which contains detailed information on the PPE supply per month by state. This information includes data on stock levels of available N95 masks, surgical masks, gloves, gowns, and eye protection. The data were collected weekly from a survey distributed to all United States hospitals and that were compiled in a document entitled the "Unified Hospital Data Sheet." The only publicly available information is only available in PDF form as bar graphs in the state profile reports. The department is not able to release the raw data that was used to make these graphs. Think-Cell is utilized to extract data from these PDF documents to have a quantifiable analysis performed on the state of PPE by the US states. Think-Cell has created a program that allows for the extraction of data from images. It utilizes the number of pixels in the image (in this case, bar charts) to extrapolate the data used to generate the chart based on the selected chart type and input values of the axes. Think-Cell was downloaded, and a 100 percent column graph was chosen as the chart type. The program was then used to extract data values for the graphs and the data are exported to Excel for further analysis.

Data regarding COVID-19 cases are obtained from the CDC in their "Restricted Access Dataset." Refer to Appendix A for details on the information contained in the dataset. Access to the database was requested and approved for use in this project. The data was then downloaded from GitHub. The data included in the dissertation were the weeks starting 1/24/2021 to 08/13/2021. These data were chosen based on the availability of the published data from the HHS.

Data Analysis. The data were transferred to SPSS for further data analysis. The data were sorted by state and then by healthcare workers' status. Cases were standardized by population size and included in terms of 100,000 individuals. States were included if there were reported healthcare worker infections, which left 18 of 52 states and territories. Tests of normality and homoscedasticity were completed, and states were excluded if there was any non-normal distribution or heteroscedasticity. This left 11 of 52 states as part of the analysis – Arkansas, California, Idaho, Kansas, Massachusetts, Michigan, Minnesota, Nevada, New Hampshire, Ohio, and Tennessee. Individual linear regression is completed with infections as the DV and each of the PPE preparedness measures (N95s, surgical masks, surgical gown, gloves, or eye protection) as IV.

Chapter 4

Results

Descriptive Statistics

Descriptive statistics can be found in Table 2. The dataset from the CDC contained 10,158,891 cases over the 30 weeks (about 7 months) analyzed for this dissertation. When evaluating the average number of infected HCWs over the 30 weeks examined in the remaining 11 states, 2,906,873 cases were remaining for analysis. The average number of infections in HCWs per 100,000 HCWs per week was 128.9 infections with a standard deviation of 121 and the average number of infections in the general population per 100,000 individuals in the population per week was 104.2 with a standard deviation of 89.8. A visual representation of the number of infections in HCWs and the general population can be seen in Figure 2. Females comprised just over half of the total infections at 51.2% and white infections made up 48.3% of the infections. The average age of the individuals in the reported infections was 40 years old. 87.7% of reporting hospitals in the sample had 2 weeks or more supply remaining of N95 masks. 86.9% had an adequate supply of surgical masks. 86.3% had 2 weeks or more supply of surgical gowns. 86.4% were prepared with gloves and 89.5% with eye protection. Figure 1 represents the change in the preparedness of the 5 different types of PPE studied over the 30 weeks included in the analysis. The average number of healthcare worker infections per state is represented in Figure 3, where there is a significant difference in the average number of infections in HCWs in the 11 states included.

Relationships between Preparedness and Infections

A summary of the relationship between PPE supply chain preparedness and HCWs infection is summarized in Table 14. Tables 3-7 detail the relationships between each of the PPE preparedness and HCWs infections. There is a statistically significant relationship between healthcare worker infections and N95 mask preparedness, surgical mask preparedness, and glove preparedness. In a regression model of PPE preparedness and HCWs infections, N95 preparedness accounts for 2.5% of the overall variation of HCWs infections (Table 3) and it has a statistically significant negative relationship with HCWs infections (R^2=0.025, $p<0.05$, B= -3.624, robust SE =1.284). A B value of -3.624 implies that with a 1% increase in preparedness, there is expected to be a decrease in healthcare worker infections by 3.624 per 100,000 HCWs. When control variables of average age, % female infected, and % white infected are added to the model, N95 mask preparedness and control variables account for 5.4% of the variation in HCWs worker infections and N95 masks have a statistically significant negative relationship with HCWs infections (R^2=0.054, $p<0.001$, B= -4.528, robust SE =1.442). If the infection of GP per 100k is added to the overall regression model, the R2 value increases nearly 10-fold, while the relationship remains significant and N95 mask preparedness remains a significant predictor (R^2=0.539, $p<0.05$, B= -2.388, robust SE =1.047).

Evaluating the relationship between HCWs infections and surgical mask preparedness, surgical mask preparedness accounts for 4.8% of the overall variation of HCWs infections (Table 4) and it has a statistically significant negative relationship with HCWs infections (R^2=0.048, $p<0.001$, B= -5.763, robust SE =1.609). When control variables of average age, % female infected, and % white infected, surgical mask preparedness and control variables account for 11.5% of the variation of HCWs infections (Table 5) and surgical masks have a statistically significant negative relationship with infections (R^2=0.115, $p<0.001$, B= -9.878, robust SE =1.932). In a model controlled by infections in the general population, race, gender, and age, surgical masks are a significant predictor of HCWs infections (R^2=0.581, $p<.001$, B= -7.386, robust SE =1.379).

Surgical gown preparedness is the only variable that does not have a significant relationship with HCWs infections, $p>0.05$ (Table 6). This relationship is not altered when the model is controlled by age, gender, race, or infections in the general population.

Glove preparedness alone explains 3.2% of the variability in HCWs infections ($R^2=0.032$, $p<0.05$, B= -4.212, robust SE =1.343). When control variables of age, gender, and race were added to the relationship, the combination of the control variables and glove preparedness explains 7.3% of the variation in HCWs infections (Table 7) and has a significant negative relationship with the HCWs infections ($R^2=0.073$, $p<0.001$, B= -6.168, robust SE = 1.647). When an additional control variable of infections in the general population is added to the model with the other control variables, glove preparedness remains a significant predictor of HCWs infections ($R^2=0.551$, $p<0.001$, B= -3.923, robust SE =1.186).

Finally, eye protection preparedness alone explains 2.7% of the variation in HCWs infections ($R^2=.027$, $p<.05$, B= -3.695, robust SE =1.626). Eye protection preparedness in combination with control variables of age, gender, and race explains 5.4% and has a significant negative relationship with HCWs infections ($R^2=.054$, $p<.001$, B= -4.417, robust SE =1.835). Interestingly, this relationship does not survive the addition of infections in the general population to the model, and eye protection no longer significantly predicts the relationship to HCWs infections ($R^2=0.534$, $p>0.05$, B= -1.687, robust SE =1.249). The implications of these findings are further addressed in the discussion below.

Interactions between PPEs

Table 8 summarizes the interaction effect between PPE preparedness. Each of the PPE was compared directly to another PPE pairwise in a model to examine the interactions between the variables in the linear regressions. The VIF values reported fall between 1 and 4 with a mean of 2.124, which is less than 10 and greater than 1, which indicates that there is limited concern about collinearity between the PPE (Pardoe, Simon, & Young, 2018).

State effects

State random effects were examined by evaluating random effects models and are summarized in Tables 9-13. Based on a random effect model of the interaction between states and N95 mask preparedness, there is a highly significant difference in the intercept of the relationship between N95 preparedness and HCWs infections between states (Δ-2LL = 35.97) when controlled for the percentage of females infected, the average age of infected individuals, and the percentage of infections in white individuals. In a random effect model of states and surgical mask preparedness, there is a highly significant difference in the intercept of the relationship between surgical mask preparedness and HCWs infections between states (Δ-2LL = 22.419) when controlled for percent of females infected, average age of infected individuals, and percent of infections in white individuals. There is a highly significant difference in the intercept of the relationship between surgical gown preparedness and HCWs infections between states (Δ-2LL = 39.665) when controlled for the percentage of females infected, the average age of infected individuals, and the percentage of infections in white individuals. There is a highly significant difference in the intercept of the relationship between gloves preparedness and HCWs infections between states (Δ-2LL = 43.273) when controlled for percent of females infected, average age of infected individuals, and percent of infections in white individuals. Based on this random effect model, there is a highly significant difference in the intercept of the relationship between eye protection preparedness and HCWs infections between states (Δ-2LL = 38.026) when controlled for the percentage of females infected, the average age of infected individuals, and the percentage of infections in white individuals.

Figure 3 demonstrates the average number of infections in HCWs and the general population by state. When compared to the average number of infections in both the general population and in HCW, there seem to be a few states that have a significantly lower number of infections in HCWs. Michigan and Massachusetts have reported infections in HCWs that are far below the mean across the states. Figure 4 shows the average preparedness of each of the PPE for the states in this study, which demonstrates that there does not appear to be a difference in the average preparedness between the states. The implications of these findings are further discussed in the limitations section below.

Chapter 5

Discussion, Limitation, Conclusions, and Practical Implications

Discussion

Based on the results of these analyses, there is a significant negative relationship between preparedness of PPE and healthcare worker infections, but this relationship is only significant for N95 masks, surgical masks, and gloves. These results imply that when there is a lack of adequate supply of appropriate PPE, there is a greater number of healthcare worker infections. The regression analyses performed in this research demonstrate that even though the percentage of variation in healthcare worker infections explained is low, PPE preparedness remains a significant predictor on its own in a model with HCWs infections. These relationships survive with the addition of the control variables of age, gender, and race. The relationship between HCWs infections and PPE preparedness is better explained with a model that includes infections in the general population. This is likely related to the risk of exposure of the HCWs. Where there are no infections in the general population, the likelihood of exposure is much lower, and therefore the impact of adequately supplied PPE is much less. For N95 masks, surgical masks, and gloves, more than 50% of the variation in healthcare worker infections can be explained by the relationship with age, gender, race, infections in the general population, and PPE preparedness. The value of the correlation coefficients for each of the PPE is negative for the three significant PPE types and the coefficient is large, suggesting that the effect of the PPE is great on the prediction of HCWs infections when all other predictors are held constant. With a B value of -7.368 for surgical masks, -3.923 for gloves, and -2.388 for N95 masks, this implies that there is a greater impact of surgical mask preparedness on overall infections, followed by gloves, and N95 masks. The correlation between PPE preparedness and HCWs infections demonstrates the importance of adequate preparedness for times of disaster to preserve the lives of those able to care for others who are ill. More importantly, the findings that not all forms of PPE display the same amount of significance to the overall reduction in the number of HCWs infections suggests that there may be room for optimization of the allocation of resources to obtain and maintain the supply of N95 masks, surgical masks, and gloves when there is a novel virus pandemic over maintaining the supply of surgical gowns and eye protection.

Surgical gowns, while highly discussed in the media and elsewhere at the height of the pandemic due to lack of supply and innovative solutions for its replacement, such as using garbage bags as a substitute for gowns, do not have a significant relationship with healthcare workers infections throughout all the analysis performed in this dissertation. Eye protection has a significant negative relationship with HCWs infections when excluding infections in the general population. There is not a significant relationship when accounting for infections in the general population, which may indicate that the importance of eye protection depends less on the incidence of infection in the area but may still be a factor in reducing healthcare worker infections. Based on this finding, hospitals should remove their focus from the supply of surgical gowns and eye protection and focus on the preparedness of other forms of PPE such as N95 masks, surgical masks, and gloves.

There may be an effect of the states on the overall interpretation of the results, but the interpretation of the effect of the states is challenged by the wide variation in the number of reported healthcare worker infections in each state. It is thought that there is a limited true effect of the state on the overall findings of this research.

This research demonstrates that PPE preparedness is an essential component of the prevention of infection in HCWs. This research can be used in future research tasks aimed at examining how hospitals responded to the COVID-19 pandemic and how the recovery shapes the next steps in preparation for the next global pandemic.

Limitations

There are several limitations to this research. The first of which is the available timeline of PPE data released by the HHS. This dataset begins in the first weeks of January 2021. It does not appear that before this time there was a centralized means of distributing this public information before January 2021 and it is possible that the data were not collected before this time as well. Should the data regarding PPE supply from the beginning months of the pandemic into the summer of 2020 become available for study, this would be essential to study, as this is the time that appears to have had the greatest stress on the PPE supply chain and the hospital inventory supply chain based on reports in the media and other sources. The lack of data does not undermine the current research, as the supply chain was still disrupted during this time and there was a nationwide surge of cases that placed stress on the already fragile PPE supply chain.

This research is also limited by the size of the sample included in the study. Unfortunately, the data regarding the cases reported to the CDC had very limited reporting of the healthcare worker status, such that only 18 of the 52 states and territories were eligible for analysis, which left only 11 for final analysis based on the preliminary testing of the data. While there was intent in this research to attempt to examine the differences between states, this examination was limited due to the significant differences in healthcare worker infections in the states remaining.

It is unknown if the overall differences in healthcare worker infections can be attributed to a difference in preparedness between the states and this does not seem to be represented by the average preparedness of the states over the 30 weeks studied. It is possible that since the healthcare worker status was self-reported in the data collected by the CDC, the number of healthcare worker infections has been underreported. Healthcare worker status was a question with available answer options of “Yes,” “No,” and “Unknown,” and only those listed as “Yes” were sorted as though truly representative of HCWs infection. The CDC does report, however, that this question can have gone unanswered, adding a category of "Missing” to the data collected. Without a requirement to answer the question, there could be an error in the estimate of the number of healthcare worker infections in each of the states. The impact of the small number of states included was mitigated by the aggregation of state data to look at the overall impact of PPE preparedness on HCWs infections, rather than examining factors that may have led to one state being more successful at mitigating infections over another. These results are no less impactful and may lead to better generalization than examining states individually.

Conclusion and Implications for Practitioners

While the results of these analyses represent the impact of PPE supply chain preparedness on the overall infection of HCW, it lays the groundwork for future research into the role of PPE supply chain resilience and its person-level impacts amid global outbreaks. Adequate supplies of N95 masks, surgical masks, and gloves are an essential component in reducing infections among HCWs. When the supply chain is unable to keep up with rapid changes in supply during a novel virus pandemic, the impact can be large, so focus should be made to ensure adequate preparedness for the PPE types that have the largest impact on infection prevention. The next steps in this research should commence upon the resolution of the pandemic and involve prompt analysis of the response and recovery of the PPE supply chain. This research should then be used to guide PPE supply chain management to create more resilient supply chains that may withstand similar disruptions in the future. HCWs are essential parts of the fight against global pandemics and hospitals and other healthcare entities should do their part to protect their workers from infection by first starting with creating more prepared supply chains before future pandemics.

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Data Tables

Table 1

Variable Descriptions

Variable	Description
Healthcare worker	Individuals whose healthcare worker status answer is “yes” on the CDC Case Surveillance Data
General population	Individuals whose healthcare worker status answer is “no,” “unknown,” or “missing” on the CDC Case Surveillance Data
Total population	All individual cases reported to the CDC in the Case Surveillance Data
Infections/deaths	Infections are reported in cases per 100,000 individuals in the population of the state and determined by the report of “case earliest date” in the CDC Case Surveillance Data. Deaths are reported as “yes,” “no,” “missing,” or “unknown” and only those reported as “yes” are considered deaths for this research
PPE	Personal protective equipment – N95 respirators, surgical masks, surgical gowns, gloves, and eye protection
PPE supply level	Percent of hospitals reporting 0-3, 4-6, 7-13, 14-30, 31+ days of supply remaining; grouped into 1 week of supply remaining, 2 weeks or more
PPE supply chain resilience	Consists of the process that encompasses preparedness, response, recovery/growth. For the sake of this research, it will be defined as preparedness
Preparedness	Percent of hospitals by state reporting 2 or more weeks of PPE supply remaining per domain

Variables and descriptions for the variables included in this study.

Table 2

Descriptive statistics

	N	Mean	SD
Infected HCWs per 100K	330	128.898	121.076
Infected GP per 100K	330	104.227	89.820
% females infected	330	0.512	0.020
Average age	330	40.450	1.267
% White infected	330	0.483	0.143
N95 prepared	330	87.745	5.312
Surgical masks prepared	330	86.991	4.609
Surgical gowns prepared	330	86.284	5.076
Gloves prepared	330	86.408	5.128
Eye protection prepared	330	89.517	5.337

Table 3

N95 Masks Preparedness

	R2	B	Robust SE
Standard regression model[a]	0.025**	-3.624**	1.284
Controlled regression model[b]	0.054***	-4.528***	1.442
Controlled regression model[c]	0.539**	-2.388**	1.047

a. DV: Infected HCWs per 100k, predictors: N95 preparedness
b. DV: Infected HCWs per 100k, predictors: N95 preparedness, % females infected, average age infected, % white infected
c. DV: Infected HCWs per 100k, predictors: Infected GP per 100K, average age, %females infected, % white infected, N95 preparedness

** p<0.05; *** p<0.001

Table 4

Surgical Masks Preparedness

	R2	B	Robust SE
Standard regression model[a]	0.048***	-5.763***	1.609
Controlled regression model[b]	0.115***	-9.878***	1.932
Controlled regression model[c]	0.581***	-7.386***	1.379

a. DV: Infected HCWs per 100k, predictors: surgical mask preparedness
b. DV: Infected HCWs per 100k, predictors: surgical mask preparedness, % females infected, average age infected, % white infected
c. DV: Infected HCWs per 100k, predictors: Infected GP per 100K, average age, %females infected, % white infected, surgical mask preparedness

** p<0.05; *** p<0.001

Table 5

Surgical Gown Preparedness

	R2	B	Robust SE
Standard regression model[a]	0.002	-1.051	1.284
Controlled regression model[b]	0.026	-1.957	1.502
Controlled regression model[c]	0.530	0.290	1.135

a. DV: Infected HCWs per 100k, predictors: surgical gown preparedness
b. DV: Infected HCWs per 100k, predictors: surgical gown preparedness, % females infected, average age infected, % white infected
c. DV: Infected HCWs per 100k, predictors: Infected GP per 100K, average age, %females infected, % white infected, surgical gown preparedness

** p<0.05; *** p<0.001

Table 6

Glove Preparedness

	R2	B	Robust SE
Standard regression model[a]	0.032**	-4.212**	1.343
Controlled regression model[b]	0.073***	-6.168***	1.647
Controlled regression model[c]	0.551***	-3.923***	1.186

a. DV: Infected HCWs per 100k, predictors: glove preparedness
b. DV: Infected HCWs per 100k, predictors: glove preparedness, % females infected, average age infected, % white infected
c. DV: Infected HCWs per 100k, predictors: Infected GP per 100K, average age, %females infected, % white infected, glove preparedness

** p<0.05; *** p<0.001

Table 7

Eye Protection Preparedness

	R2	B	Robust SE
Standard regression model[a]	0.027**	-3.695**	1.626
Controlled regression model[b]	0.054***	-4.417***	1.835
Controlled regression model[c]	0.534	-1.687	1.249

a. DV: Infected HCWs per 100k, predictors: eye protection preparedness
b. DV: Infected HCWs per 100k, predictors: eye protection preparedness, % females infected, average age infected, % white infected
c. DV: Infected HCWs per 100k, predictors: Infected GP per 100K, average age, %females infected, % white infected, eye protection preparedness

** p<0.05; *** p<0.001

Table 8

Interaction effects model between PPEs

	VIF
N95 mask preparedness and surgical mask preparedness	1.453
N95 mask preparedness and surgical gown preparedness	3.461
N95 mask preparedness and glove preparedness	3.046
N95 mask preparedness and eye protection preparedness	1.360
Surgical mask preparedness and surgical gown preparedness	1.568
Surgical mask preparedness and glove preparedness	2.390
Surgical mask preparedness and eye protection preparedness	1.169
Surgical gown preparedness and glove preparedness	4.145
Surgical gown preparedness and eye protection preparedness	1.393
Glove preparedness and eye protection preparedness	1.256

Table 9
Random effects model, states x N95 masks

	-2LL	df
Fixed effect model	4046.558	6
Random effect model	4010.588	7
Difference between models	35.97	1

Table 10
Random effects model, states x surgical masks

	-2LL	df
Fixed effect model	4046.558	6
Random effect model	4010.588	7
Difference between models	35.97	1

Table 11
Random effects model, states x surgical gowns

	-2LL	df
Fixed effect model	4055.659	6
Random effect model	4015.904	7
Difference between models	39.665	1

Table 12
Random effects model, states x gloves

	-2LL	df
Fixed effect model	4039.595	6
Random effect model	3996.322	7
Difference between models	43.273	1

Table 13
Random effects model, states x eye protection

	-2LL	df
Fixed effect model	4046.678	6
Random effect model	4008.652	7
Difference between models	38.026	1

Table 14
Summary table of regression models

PPE Preparedness	Effect on HCWs Infections	Significant?
N95 Masks	Negative	Yes
Surgical Masks	Negative	Yes
Surgical Gowns	Negative	No
Gloves	Negative	Yes
Eye Protection	Negative	No

Charts

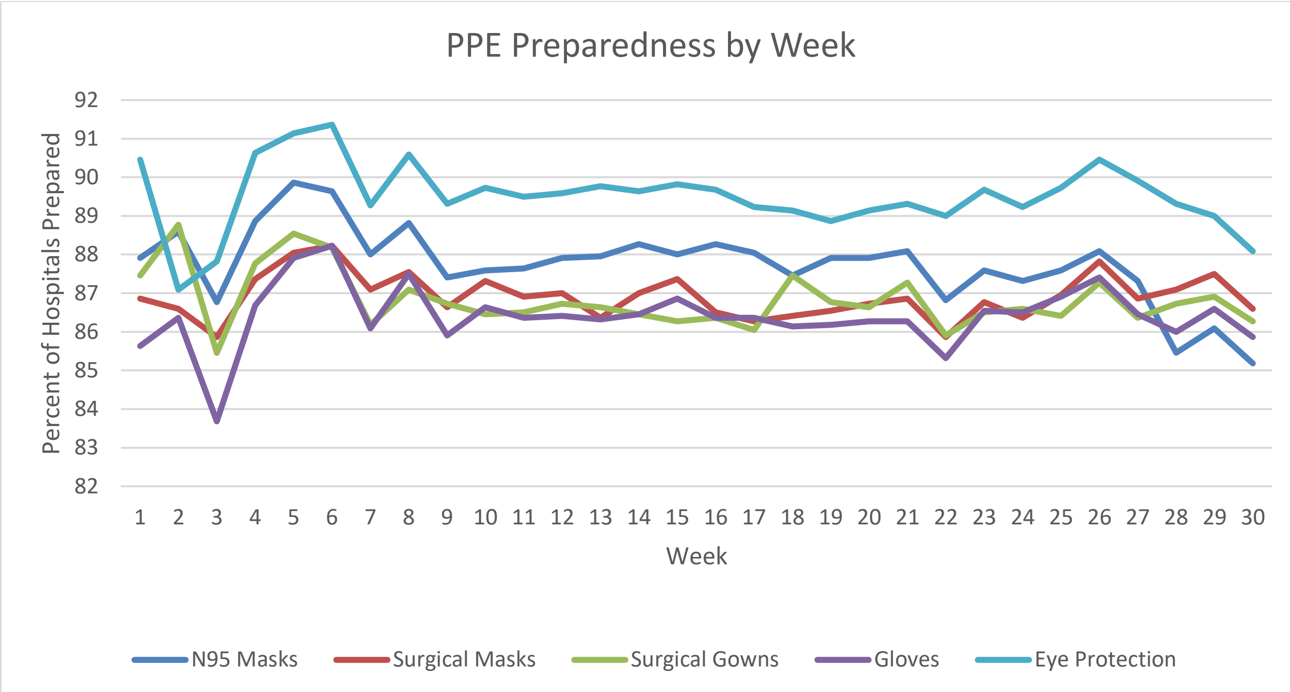

Figure 1. PPE Preparedness by Week. As seen, the different PPE types have similar average percent of hospitals supplied over the 30 weeks studied.

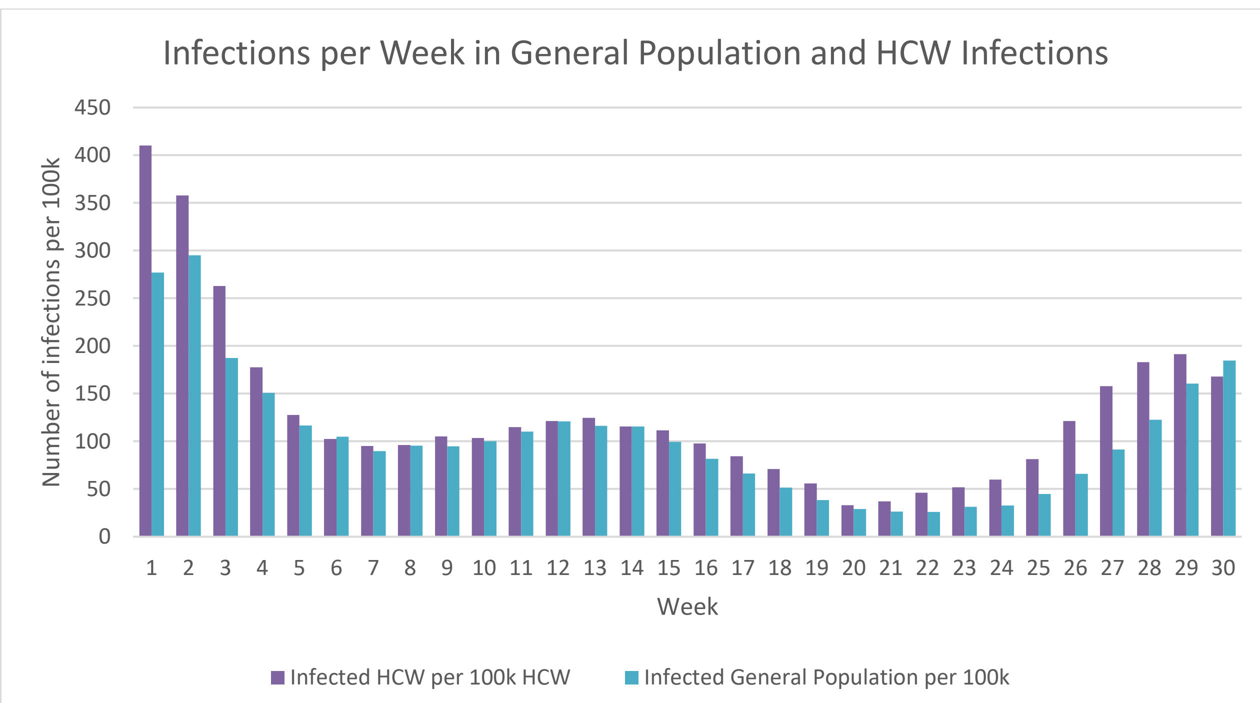

Figure 2. Infections per week in the general population and HCW represented a number of infections per 100,000 individuals

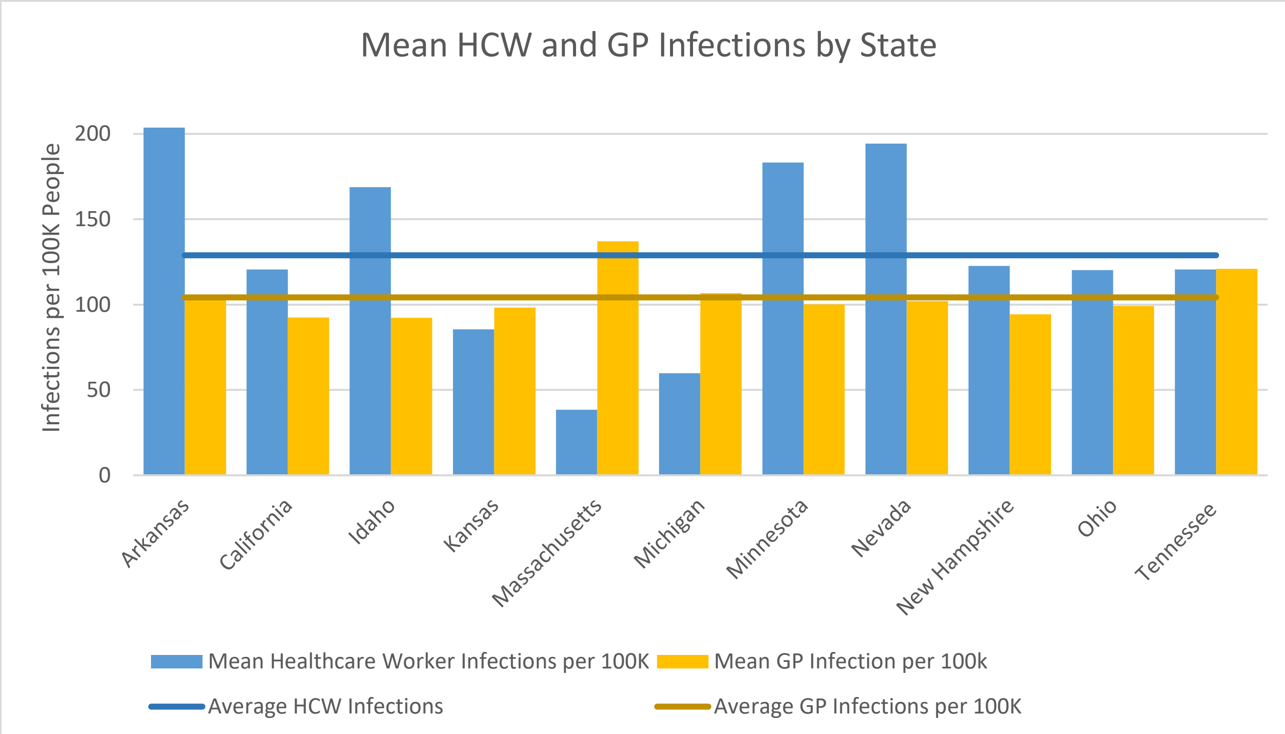

Figure 3. The average number of healthcare workers and general population infections per 100k by state. Mean infections between the states studied are represented by their respective lines.

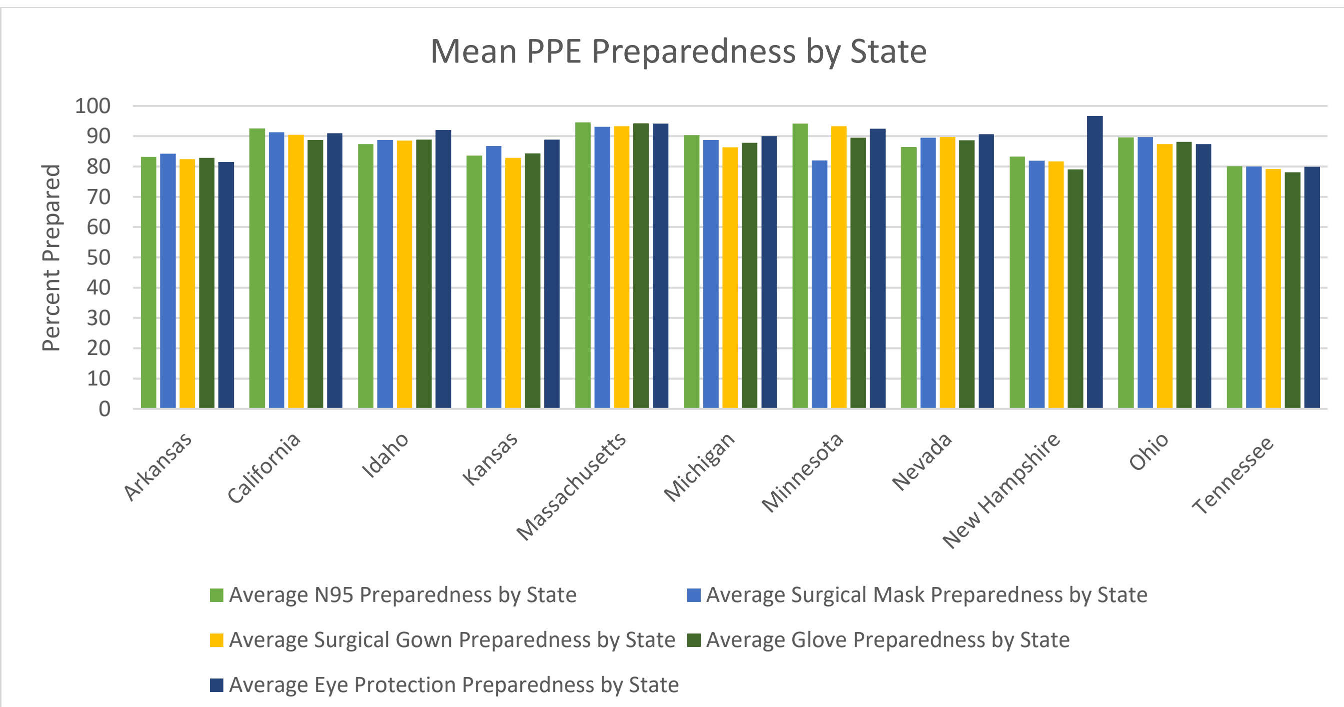

Figure 4. Average preparedness of N95 masks, surgical masks, surgical gowns, gloves, and eye protection by the state.

Appendix A – Additional Analyses

ANOVA – Healthcare Worker Infections

ANOVA
Infected HCWs per 100k

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	884295.737	10	88429.574	7.162	<.001
Within Groups	3938613.037	319	12346.749		
Total	4822908.774	329			

	(I) StateNum	(J) StateNum	Mean Difference (I-J)	Std. Error	Sig.
Games-Howell	ARKANSAS	CALIFORNIA	82.987611	41.769219	.658
		IDAHO	34.746130	37.867110	.997
		KANSAS	118.152429	38.152676	.105
		MASSACHUSETTS	165.130230*	36.014314	.003
		MICHIGAN	143.751112*	35.898791	.013
		MINNESOTA	20.439601	40.564037	1.000
		NEVADA	9.362113	44.741122	1.000
		NEW HAMPSHIRE	80.898962	40.213933	.642
		OHIO	83.475200	39.323951	.568
		TENNESSEE	83.005794	39.251738	.574
	CALIFORNIA	ARKANSAS	-82.987611	41.769219	.658
		IDAHO	-48.241481	26.912901	.779
		KANSAS	35.164818	27.313237	.967
		MASSACHUSETTS	82.142619	24.236687	.055
		MICHIGAN	60.763501	24.064691	.324
		MINNESOTA	-62.548010	30.591295	.620
		NEVADA	-73.625498	35.946546	.617
		NEW HAMPSHIRE	-2.088649	30.125514	1.000
		OHIO	.487589	28.926793	1.000
		TENNESSEE	.018182	28.828548	1.000
	IDAHO	ARKANSAS	-34.746130	37.867110	.997
		CALIFORNIA	48.241481	26.912901	.779
		KANSAS	83.406299*	20.862965	.008
		MASSACHUSETTS	130.384100*	16.633321	<.001
		MICHIGAN	109.004982*	16.381690	<.001

	MINNESOTA	-14.306529	25.001554	1.000
	NEVADA	-25.384017	31.327377	.999
	NEW HAMPSHIRE	46.152832	24.429429	.721
	OHIO	48.729070	22.934902	.566
	TENNESSEE	48.259664	22.810865	.572
KANSAS	ARKANSAS	-118.152429	38.152676	.105
	CALIFORNIA	-35.164818	27.313237	.967
	IDAHO	-83.406299*	20.862965	.008
	MASSACHUSETTS	46.977802	17.273565	.224
	MICHIGAN	25.598683	17.031395	.911
	MINNESOTA	-97.712828*	25.431995	.013
	NEVADA	-108.790316*	31.671963	.045
	NEW HAMPSHIRE	-37.253467	24.869774	.914
	OHIO	-34.677229	23.403384	.920
	TENNESSEE	-35.146635	23.281843	.911
MASSACHUSETTS	ARKANSAS	-165.130230*	36.014314	.003
	CALIFORNIA	-82.142619	24.236687	.055
	IDAHO	-130.384100*	16.633321	<.001
	KANSAS	-46.977802	17.273565	.224
	MICHIGAN	-21.379119	11.466146	.737
	MINNESOTA	-144.690629*	22.095032	<.001
	NEVADA	-155.768117*	29.060580	<.001
	NEW HAMPSHIRE	-84.231269*	21.445506	.013
	OHIO	-81.655031*	19.726187	.007
	TENNESSEE	-82.124437*	19.581836	.006
MICHIGAN	ARKANSAS	-143.751112*	35.898791	.013
	CALIFORNIA	-60.763501	24.064691	.324
	IDAHO	-109.004982*	16.381690	<.001
	KANSAS	-25.598683	17.031395	.911
	MASSACHUSETTS	21.379119	11.466146	.737
	MINNESOTA	-123.311511*	21.906228	<.001
	NEVADA	-134.388999*	28.917291	.002
	NEW HAMPSHIRE	-62.852150	21.250933	.143
	OHIO	-60.275912	19.514478	.107
	TENNESSEE	-60.745318	19.368549	.096
MINNESOTA	ARKANSAS	-20.439601	40.564037	1.000
	CALIFORNIA	62.548010	30.591295	.620
	IDAHO	14.306529	25.001554	1.000

	KANSAS	97.712828*	25.431995	.013
	MASSACHUSETTS	144.690629*	22.095032	<.001
	MICHIGAN	123.311511*	21.906228	<.001
	NEVADA	-11.077488	34.538784	1.000
	NEW HAMPSHIRE	60.459361	28.430970	.564
	OHIO	63.035599	27.157555	.434
	TENNESSEE	62.566193	27.052886	.440
NEVADA	ARKANSAS	-9.362113	44.741122	1.000
	CALIFORNIA	73.625498	35.946546	.617
	IDAHO	25.384017	31.327377	.999
	KANSAS	108.790316*	31.671963	.045
	MASSACHUSETTS	155.768117*	29.060580	<.001
	MICHIGAN	134.388999*	28.917291	.002
	MINNESOTA	11.077488	34.538784	1.000
	NEW HAMPSHIRE	71.536849	34.126924	.585
	OHIO	74.113087	33.073549	.489
	TENNESSEE	73.643680	32.987657	.494
NEW HAMPSHIRE	ARKANSAS	-80.898962	40.213933	.642
	CALIFORNIA	2.088649	30.125514	1.000
	IDAHO	-46.152832	24.429429	.721
	KANSAS	37.253467	24.869774	.914
	MASSACHUSETTS	84.231269*	21.445506	.013
	MICHIGAN	62.852150	21.250933	.143
	MINNESOTA	-60.459361	28.430970	.564
	NEVADA	-71.536849	34.126924	.585
	OHIO	2.576238	26.631787	1.000
	TENNESSEE	2.106832	26.525043	1.000
OHIO	ARKANSAS	-83.475200	39.323951	.568
	CALIFORNIA	-.487589	28.926793	1.000
	IDAHO	-48.729070	22.934902	.566
	KANSAS	34.677229	23.403384	.920
	MASSACHUSETTS	81.655031*	19.726187	.007
	MICHIGAN	60.275912	19.514478	.107
	MINNESOTA	-63.035599	27.157555	.434
	NEVADA	-74.113087	33.073549	.489
	NEW HAMPSHIRE	-2.576238	26.631787	1.000
	TENNESSEE	-.469406	25.155330	1.000
TENNESSEE	ARKANSAS	-83.005794	39.251738	.574

	CALIFORNIA	-.018182	28.828548	1.000
	IDAHO	-48.259664	22.810865	.572
	KANSAS	35.146635	23.281843	.911
	MASSACHUSETTS	82.124437*	19.581836	.006
	MICHIGAN	60.745318	19.368549	.096
	MINNESOTA	-62.566193	27.052886	.440
	NEVADA	-73.643680	32.987657	.494
	NEW HAMPSHIRE	-2.106832	26.525043	1.000
	OHIO	.469406	25.155330	1.000

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
N95 Prepared	Between Groups	7171.768	10	717.177	108.383	<.001
	Within Groups	2110.850	319	6.617		
	Total	9282.618	329			
Surgical Masks Prepared	Between Groups	5504.988	10	550.499	118.445	<.001
	Within Groups	1482.625	319	4.648		
	Total	6987.613	329			
Surgical Gowns Prepared	Between Groups	6890.373	10	689.037	138.552	<.001
	Within Groups	1586.433	319	4.973		
	Total	8476.806	329			
Gloves Prepared	Between Groups	6994.389	10	699.439	134.732	<.001
	Within Groups	1656.042	319	5.191		
	Total	8650.431	329			
Eye Protection Prepared	Between Groups	7572.617	10	757.262	134.425	<.001
	Within Groups	1797.042	319	5.633		
	Total	9369.658	329			

Dependent Variable	(I) StateNum	(J) StateNum	Mean Difference (I-J)	Std. Error	Sig.
N95 Prepared	ARKANSAS	CALIFORNIA	-9.3500*	.2054	<.001
		IDAHO	-4.2167*	.8772	.002
		KANSAS	-.4333	.3146	.947
		MASSACHUSETTS	-11.3833*	.1716	<.001
		MICHIGAN	-7.1333*	.6455	<.001
		MINNESOTA	-11.0000*	.2846	<.001
		NEVADA	-3.2167*	.6338	<.001
		NEW HAMPSHIRE	-.0833	.4276	1.000
		OHIO	-6.4333*	.2725	<.001

	TENNESSEE	3.0667*	.7201	.007
CALIFORNIA	ARKANSAS	9.3500*	.2054	<.001
	IDAHO	5.1333*	.8773	<.001
	KANSAS	8.9167*	.3150	<.001
	MASSACHUSETTS	-2.0333*	.1723	<.001
	MICHIGAN	2.2167	.6457	.053
	MINNESOTA	-1.6500*	.2851	<.001
	NEVADA	6.1333*	.6340	<.001
	NEW HAMPSHIRE	9.2667*	.4280	<.001
	OHIO	2.9167*	.2729	<.001
	TENNESSEE	12.4167*	.7202	<.001
IDAHO	ARKANSAS	4.2167*	.8772	.002
	CALIFORNIA	-5.1333*	.8773	<.001
	KANSAS	3.7833*	.9091	.008
	MASSACHUSETTS	-7.1667*	.8700	<.001
	MICHIGAN	-2.9167	1.0697	.216
	MINNESOTA	-6.7833*	.8992	<.001
	NEVADA	1.0000	1.0626	.997
	NEW HAMPSHIRE	4.1333*	.9542	.004
	OHIO	-2.2167	.8954	.354
	TENNESSEE	7.2833*	1.1163	<.001
KANSAS	ARKANSAS	.4333	.3146	.947
	CALIFORNIA	-8.9167*	.3150	<.001
	IDAHO	-3.7833*	.9091	.008
	MASSACHUSETTS	-10.9500*	.2940	<.001
	MICHIGAN	-6.7000*	.6882	<.001
	MINNESOTA	-10.5667*	.3715	<.001
	NEVADA	-2.7833*	.6773	.008
	NEW HAMPSHIRE	.3500	.4898	1.000
	OHIO	-6.0000*	.3623	<.001
	TENNESSEE	3.5000*	.7586	.002
MASSACHUSETTS	ARKANSAS	11.3833*	.1716	<.001
	CALIFORNIA	2.0333*	.1723	<.001
	IDAHO	7.1667*	.8700	<.001
	KANSAS	10.9500*	.2940	<.001
	MICHIGAN	4.2500*	.6357	<.001
	MINNESOTA	.3833	.2618	.922
	NEVADA	8.1667*	.6238	<.001
	NEW HAMPSHIRE	11.3000*	.4128	<.001
	OHIO	4.9500*	.2485	<.001
	TENNESSEE	14.4500*	.7113	<.001
MICHIGAN	ARKANSAS	7.1333*	.6455	<.001
	CALIFORNIA	-2.2167	.6457	.053

	IDAHO	2.9167	1.0697	.216
	KANSAS	6.7000*	.6882	<.001
	MASSACHUSETTS	-4.2500*	.6357	<.001
	MINNESOTA	-3.8667*	.6751	<.001
	NEVADA	3.9167*	.8811	.002
	NEW HAMPSHIRE	7.0500*	.7467	<.001
	OHIO	.7000	.6700	.992
	TENNESSEE	10.2000*	.9451	<.001
MINNESOTA	ARKANSAS	11.0000*	.2846	<.001
	CALIFORNIA	1.6500*	.2851	<.001
	IDAHO	6.7833*	.8992	<.001
	KANSAS	10.5667*	.3715	<.001
	MASSACHUSETTS	-.3833	.2618	.922
	MICHIGAN	3.8667*	.6751	<.001
	NEVADA	7.7833*	.6639	<.001
	NEW HAMPSHIRE	10.9167*	.4711	<.001
	OHIO	4.5667*	.3366	<.001
	TENNESSEE	14.0667*	.7467	<.001
NEVADA	ARKANSAS	3.2167*	.6338	<.001
	CALIFORNIA	-6.1333*	.6340	<.001
	IDAHO	-1.0000	1.0626	.997
	KANSAS	2.7833*	.6773	.008
	MASSACHUSETTS	-8.1667*	.6238	<.001
	MICHIGAN	-3.9167*	.8811	.002
	MINNESOTA	-7.7833*	.6639	<.001
	NEW HAMPSHIRE	3.1333*	.7366	.004
	OHIO	-3.2167*	.6588	<.001
	TENNESSEE	6.2833*	.9371	<.001
NEW HAMPSHIRE	ARKANSAS	.0833	.4276	1.000
	CALIFORNIA	-9.2667*	.4280	<.001
	IDAHO	-4.1333*	.9542	.004
	KANSAS	-.3500	.4898	1.000
	MASSACHUSETTS	-11.3000*	.4128	<.001
	MICHIGAN	-7.0500*	.7467	<.001
	MINNESOTA	-10.9167*	.4711	<.001
	NEVADA	-3.1333*	.7366	.004
	OHIO	-6.3500*	.4639	<.001
	TENNESSEE	3.1500*	.8121	.013
OHIO	ARKANSAS	6.4333*	.2725	<.001
	CALIFORNIA	-2.9167*	.2729	<.001
	IDAHO	2.2167	.8954	.354
	KANSAS	6.0000*	.3623	<.001
	MASSACHUSETTS	-4.9500*	.2485	<.001

		MICHIGAN	-.7000	.6700	.992
		MINNESOTA	-4.5667*	.3366	<.001
		NEVADA	3.2167*	.6588	<.001
		NEW HAMPSHIRE	6.3500*	.4639	<.001
		TENNESSEE	9.5000*	.7421	<.001
	TENNESSEE	ARKANSAS	-3.0667*	.7201	.007
		CALIFORNIA	-12.4167*	.7202	<.001
		IDAHO	-7.2833*	1.1163	<.001
		KANSAS	-3.5000*	.7586	.002
		MASSACHUSETTS	-14.4500*	.7113	<.001
		MICHIGAN	-10.2000*	.9451	<.001
		MINNESOTA	-14.0667*	.7467	<.001
		NEVADA	-6.2833*	.9371	<.001
		NEW HAMPSHIRE	-3.1500*	.8121	.013
		OHIO	-9.5000*	.7421	<.001
Surgical Masks Prepared	ARKANSAS	CALIFORNIA	-7.1167*	.5163	<.001
		IDAHO	-4.5167*	.5227	<.001
		KANSAS	-2.4833*	.4827	<.001
		MASSACHUSETTS	-8.8333*	.4614	<.001
		MICHIGAN	-4.5167*	.6212	<.001
		MINNESOTA	2.2333*	.4647	.001
		NEVADA	-5.3167*	.7709	<.001
		NEW HAMPSHIRE	2.3667	.7191	.059
		OHIO	-5.4833*	.4725	<.001
		TENNESSEE	4.2167*	.7237	<.001
	CALIFORNIA	ARKANSAS	7.1167*	.5163	<.001
		IDAHO	2.6000*	.3909	<.001
		KANSAS	4.6333*	.3355	<.001
		MASSACHUSETTS	-1.7167*	.3041	<.001
		MICHIGAN	2.6000*	.5152	<.001
		MINNESOTA	9.3500*	.3090	<.001
		NEVADA	1.8000	.6884	.276
		NEW HAMPSHIRE	9.4833*	.6298	<.001
		OHIO	1.6333*	.3206	<.001
		TENNESSEE	11.3333*	.6350	<.001
	IDAHO	ARKANSAS	4.5167*	.5227	<.001
		CALIFORNIA	-2.6000*	.3909	<.001
		KANSAS	2.0333*	.3453	<.001
		MASSACHUSETTS	-4.3167*	.3148	<.001
		MICHIGAN	.0000	.5217	1.000
		MINNESOTA	6.7500*	.3196	<.001
		NEVADA	-.8000	.6932	.984
		NEW HAMPSHIRE	6.8833*	.6350	<.001

	OHIO	-.9667	.3308	.147
	TENNESSEE	8.7333*	.6402	<.001
KANSAS	ARKANSAS	2.4833*	.4827	<.001
	CALIFORNIA	-4.6333*	.3355	<.001
	IDAHO	-2.0333*	.3453	<.001
	MASSACHUSETTS	-6.3500*	.2426	<.001
	MICHIGAN	-2.0333*	.4815	.006
	MINNESOTA	4.7167*	.2488	<.001
	NEVADA	-2.8333*	.6635	.006
	NEW HAMPSHIRE	4.8500*	.6025	<.001
	OHIO	-3.0000*	.2630	<.001
	TENNESSEE	6.7000*	.6080	<.001
MASSACHUSETTS	ARKANSAS	8.8333*	.4614	<.001
	CALIFORNIA	1.7167*	.3041	<.001
	IDAHO	4.3167*	.3148	<.001
	KANSAS	6.3500*	.2426	<.001
	MICHIGAN	4.3167*	.4602	<.001
	MINNESOTA	11.0667*	.2045	<.001
	NEVADA	3.5167*	.6482	<.001
	NEW HAMPSHIRE	11.2000*	.5856	<.001
	OHIO	3.3500*	.2216	<.001
	TENNESSEE	13.0500*	.5912	<.001
MICHIGAN	ARKANSAS	4.5167*	.6212	<.001
	CALIFORNIA	-2.6000*	.5152	<.001
	IDAHO	.0000	.5217	1.000
	KANSAS	2.0333*	.4815	.006
	MASSACHUSETTS	-4.3167*	.4602	<.001
	MINNESOTA	6.7500*	.4635	<.001
	NEVADA	-.8000	.7702	.993
	NEW HAMPSHIRE	6.8833*	.7183	<.001
	OHIO	-.9667	.4713	.617
	TENNESSEE	8.7333*	.7229	<.001
MINNESOTA	ARKANSAS	-2.2333*	.4647	.001
	CALIFORNIA	-9.3500*	.3090	<.001
	IDAHO	-6.7500*	.3196	<.001
	KANSAS	-4.7167*	.2488	<.001
	MASSACHUSETTS	-11.0667*	.2045	<.001
	MICHIGAN	-6.7500*	.4635	<.001
	NEVADA	-7.5500*	.6505	<.001
	NEW HAMPSHIRE	.1333	.5882	1.000
	OHIO	-7.7167*	.2283	<.001
	TENNESSEE	1.9833	.5938	.065
NEVADA	ARKANSAS	5.3167*	.7709	<.001

		CALIFORNIA	-1.8000	.6884	.276
		IDAHO	.8000	.6932	.984
		KANSAS	2.8333*	.6635	.006
		MASSACHUSETTS	-3.5167*	.6482	<.001
		MICHIGAN	.8000	.7702	.993
		MINNESOTA	7.5500*	.6505	<.001
		NEW HAMPSHIRE	7.6833*	.8511	<.001
		OHIO	-.1667	.6561	1.000
		TENNESSEE	9.5333*	.8549	<.001
	NEW HAMPSHIRE	ARKANSAS	-2.3667	.7191	.059
		CALIFORNIA	-9.4833*	.6298	<.001
		IDAHO	-6.8833*	.6350	<.001
		KANSAS	-4.8500*	.6025	<.001
		MASSACHUSETTS	-11.2000*	.5856	<.001
		MICHIGAN	-6.8833*	.7183	<.001
		MINNESOTA	-.1333	.5882	1.000
		NEVADA	-7.6833*	.8511	<.001
		OHIO	-7.8500*	.5943	<.001
		TENNESSEE	1.8500	.8085	.455
	OHIO	ARKANSAS	5.4833*	.4725	<.001
		CALIFORNIA	-1.6333*	.3206	<.001
		IDAHO	.9667	.3308	.147
		KANSAS	3.0000*	.2630	<.001
		MASSACHUSETTS	-3.3500*	.2216	<.001
		MICHIGAN	.9667	.4713	.617
		MINNESOTA	7.7167*	.2283	<.001
		NEVADA	.1667	.6561	1.000
		NEW HAMPSHIRE	7.8500*	.5943	<.001
		TENNESSEE	9.7000*	.5999	<.001
	TENNESSEE	ARKANSAS	-4.2167*	.7237	<.001
		CALIFORNIA	-11.3333*	.6350	<.001
		IDAHO	-8.7333*	.6402	<.001
		KANSAS	-6.7000*	.6080	<.001
		MASSACHUSETTS	-13.0500*	.5912	<.001
		MICHIGAN	-8.7333*	.7229	<.001
		MINNESOTA	-1.9833	.5938	.065
		NEVADA	-9.5333*	.8549	<.001
		NEW HAMPSHIRE	-1.8500	.8085	.455
		OHIO	-9.7000*	.5999	<.001
Surgical Gowns Prepared	ARKANSAS	CALIFORNIA	-8.0333*	.2835	<.001
		IDAHO	-6.0667*	.2934	<.001
		KANSAS	-.3667	.2646	.947
		MASSACHUSETTS	-10.8333*	.2158	<.001

	MICHIGAN	-3.8667*	.5906	<.001
	MINNESOTA	-10.8500*	.2805	<.001
	NEVADA	-7.2833*	.6298	<.001
	NEW HAMPSHIRE	.7667	.7211	.991
	OHIO	-4.9000*	.2520	<.001
	TENNESSEE	3.3167*	.6709	<.001
CALIFORNIA	ARKANSAS	8.0333*	.2835	<.001
	IDAHO	1.9667*	.3098	<.001
	KANSAS	7.6667*	.2826	<.001
	MASSACHUSETTS	-2.8000*	.2375	<.001
	MICHIGAN	4.1667*	.5988	<.001
	MINNESOTA	-2.8167*	.2976	<.001
	NEVADA	.7500	.6375	.981
	NEW HAMPSHIRE	8.8000*	.7279	<.001
	OHIO	3.1333*	.2708	<.001
	TENNESSEE	11.3500*	.6782	<.001
IDAHO	ARKANSAS	6.0667*	.2934	<.001
	CALIFORNIA	-1.9667*	.3098	<.001
	KANSAS	5.7000*	.2926	<.001
	MASSACHUSETTS	-4.7667*	.2493	<.001
	MICHIGAN	2.2000*	.6036	.028
	MINNESOTA	-4.7833*	.3071	<.001
	NEVADA	-1.2167	.6420	.716
	NEW HAMPSHIRE	6.8333*	.7319	<.001
	OHIO	1.1667*	.2812	.005
	TENNESSEE	9.3833*	.6825	<.001
KANSAS	ARKANSAS	.3667	.2646	.947
	CALIFORNIA	-7.6667*	.2826	<.001
	IDAHO	-5.7000*	.2926	<.001
	MASSACHUSETTS	-10.4667*	.2146	<.001
	MICHIGAN	-3.5000*	.5901	<.001
	MINNESOTA	-10.4833*	.2797	<.001
	NEVADA	-6.9167*	.6294	<.001
	NEW HAMPSHIRE	1.1333	.7208	.883
	OHIO	-4.5333*	.2510	<.001
	TENNESSEE	3.6833*	.6706	<.001
MASSACHUSETTS	ARKANSAS	10.8333*	.2158	<.001
	CALIFORNIA	2.8000*	.2375	<.001
	IDAHO	4.7667*	.2493	<.001
	KANSAS	10.4667*	.2146	<.001
	MICHIGAN	6.9667*	.5699	<.001
	MINNESOTA	-.0167	.2340	1.000
	NEVADA	3.5500*	.6105	<.001

	NEW HAMPSHIRE	11.6000*	.7043	<.001
	OHIO	5.9333*	.1989	<.001
	TENNESSEE	14.1500*	.6529	<.001
MICHIGAN	ARKANSAS	3.8667*	.5906	<.001
	CALIFORNIA	-4.1667*	.5988	<.001
	IDAHO	-2.2000*	.6036	.028
	KANSAS	3.5000*	.5901	<.001
	MASSACHUSETTS	-6.9667*	.5699	<.001
	MINNESOTA	-6.9833*	.5974	<.001
	NEVADA	-3.4167*	.8215	.005
	NEW HAMPSHIRE	4.6333*	.8935	<.001
	OHIO	-1.0333	.5846	.790
	TENNESSEE	7.1833*	.8535	<.001
MINNESOTA	ARKANSAS	10.8500*	.2805	<.001
	CALIFORNIA	2.8167*	.2976	<.001
	IDAHO	4.7833*	.3071	<.001
	KANSAS	10.4833*	.2797	<.001
	MASSACHUSETTS	.0167	.2340	1.000
	MICHIGAN	6.9833*	.5974	<.001
	NEVADA	3.5667*	.6362	<.001
	NEW HAMPSHIRE	11.6167*	.7268	<.001
	OHIO	5.9500*	.2678	<.001
	TENNESSEE	14.1667*	.6770	<.001
NEVADA	ARKANSAS	7.2833*	.6298	<.001
	CALIFORNIA	-.7500	.6375	.981
	IDAHO	1.2167	.6420	.716
	KANSAS	6.9167*	.6294	<.001
	MASSACHUSETTS	-3.5500*	.6105	<.001
	MICHIGAN	3.4167*	.8215	.005
	MINNESOTA	-3.5667*	.6362	<.001
	NEW HAMPSHIRE	8.0500*	.9198	<.001
	OHIO	2.3833*	.6242	.020
	TENNESSEE	10.6000*	.8810	<.001
NEW HAMPSHIRE	ARKANSAS	-.7667	.7211	.991
	CALIFORNIA	-8.8000*	.7279	<.001
	IDAHO	-6.8333*	.7319	<.001
	KANSAS	-1.1333	.7208	.883
	MASSACHUSETTS	-11.6000*	.7043	<.001
	MICHIGAN	-4.6333*	.8935	<.001
	MINNESOTA	-11.6167*	.7268	<.001
	NEVADA	-8.0500*	.9198	<.001
	OHIO	-5.6667*	.7162	<.001
	TENNESSEE	2.5500	.9485	.231

	OHIO	ARKANSAS	4.9000*	.2520	<.001
		CALIFORNIA	-3.1333*	.2708	<.001
		IDAHO	-1.1667*	.2812	.005
		KANSAS	4.5333*	.2510	<.001
		MASSACHUSETTS	-5.9333*	.1989	<.001
		MICHIGAN	1.0333	.5846	.790
		MINNESOTA	-5.9500*	.2678	<.001
		NEVADA	-2.3833*	.6242	.020
		NEW HAMPSHIRE	5.6667*	.7162	<.001
		TENNESSEE	8.2167*	.6657	<.001
	TENNESSEE	ARKANSAS	-3.3167*	.6709	<.001
		CALIFORNIA	-11.3500*	.6782	<.001
		IDAHO	-9.3833*	.6825	<.001
		KANSAS	-3.6833*	.6706	<.001
		MASSACHUSETTS	-14.1500*	.6529	<.001
		MICHIGAN	-7.1833*	.8535	<.001
		MINNESOTA	-14.1667*	.6770	<.001
		NEVADA	-10.6000*	.8810	<.001
		NEW HAMPSHIRE	-2.5500	.9485	.231
		OHIO	-8.2167*	.6657	<.001
Gloves Prepared	ARKANSAS	CALIFORNIA	-5.9667*	.3555	<.001
		IDAHO	-6.0667*	.3363	<.001
		KANSAS	-1.5333*	.3476	.002
		MASSACHUSETTS	-11.4167*	.3305	<.001
		MICHIGAN	-4.9667*	.5130	<.001
		MINNESOTA	-6.7167*	.3504	<.001
		NEVADA	-5.8333*	.8265	<.001
		NEW HAMPSHIRE	3.8167*	.5783	<.001
		OHIO	-5.3167*	.3592	<.001
		TENNESSEE	4.6833*	.6833	<.001
	CALIFORNIA	ARKANSAS	5.9667*	.3555	<.001
		IDAHO	-.1000	.3373	1.000
		KANSAS	4.4333*	.3487	<.001
		MASSACHUSETTS	-5.4500*	.3316	<.001
		MICHIGAN	1.0000	.5137	.685
		MINNESOTA	-.7500	.3515	.559
		NEVADA	.1333	.8270	1.000
		NEW HAMPSHIRE	9.7833*	.5789	<.001
		OHIO	.6500	.3602	.773
		TENNESSEE	10.6500*	.6839	<.001
	IDAHO	ARKANSAS	6.0667*	.3363	<.001
		CALIFORNIA	.1000	.3373	1.000
		KANSAS	4.5333*	.3290	<.001

	MASSACHUSETTS	-5.3500*	.3109	<.001
	MICHIGAN	1.1000	.5006	.519
	MINNESOTA	-.6500	.3320	.677
	NEVADA	.2333	.8189	1.000
	NEW HAMPSHIRE	9.8833*	.5672	<.001
	OHIO	.7500	.3412	.515
	TENNESSEE	10.7500*	.6740	<.001
KANSAS	ARKANSAS	1.5333*	.3476	.002
	CALIFORNIA	-4.4333*	.3487	<.001
	IDAHO	-4.5333*	.3290	<.001
	MASSACHUSETTS	-9.8833*	.3231	<.001
	MICHIGAN	-3.4333*	.5083	<.001
	MINNESOTA	-5.1833*	.3435	<.001
	NEVADA	-4.3000*	.8236	<.001
	NEW HAMPSHIRE	5.3500*	.5741	<.001
	OHIO	-3.7833*	.3524	<.001
	TENNESSEE	6.2167*	.6798	<.001
MASSACHUSETTS	ARKANSAS	11.4167*	.3305	<.001
	CALIFORNIA	5.4500*	.3316	<.001
	IDAHO	5.3500*	.3109	<.001
	KANSAS	9.8833*	.3231	<.001
	MICHIGAN	6.4500*	.4967	<.001
	MINNESOTA	4.7000*	.3262	<.001
	NEVADA	5.5833*	.8165	<.001
	NEW HAMPSHIRE	15.2333*	.5639	<.001
	OHIO	6.1000*	.3355	<.001
	TENNESSEE	16.1000*	.6712	<.001
MICHIGAN	ARKANSAS	4.9667*	.5130	<.001
	CALIFORNIA	-1.0000	.5137	.685
	IDAHO	-1.1000	.5006	.519
	KANSAS	3.4333*	.5083	<.001
	MASSACHUSETTS	-6.4500*	.4967	<.001
	MINNESOTA	-1.7500*	.5102	.045
	NEVADA	-.8667	.9059	.996
	NEW HAMPSHIRE	8.7833*	.6869	<.001
	OHIO	-.3500	.5163	1.000
	TENNESSEE	9.6500*	.7775	<.001
MINNESOTA	ARKANSAS	6.7167*	.3504	<.001
	CALIFORNIA	.7500	.3515	.559
	IDAHO	.6500	.3320	.677
	KANSAS	5.1833*	.3435	<.001
	MASSACHUSETTS	-4.7000*	.3262	<.001
	MICHIGAN	1.7500*	.5102	.045

	NEVADA	.8833	.8248	.990
	NEW HAMPSHIRE	10.5333*	.5758	<.001
	OHIO	1.4000*	.3552	.009
	TENNESSEE	11.4000*	.6812	<.001
NEVADA	ARKANSAS	5.8333*	.8265	<.001
	CALIFORNIA	-.1333	.8270	1.000
	IDAHO	-.2333	.8189	1.000
	KANSAS	4.3000*	.8236	<.001
	MASSACHUSETTS	-5.5833*	.8165	<.001
	MICHIGAN	.8667	.9059	.996
	MINNESOTA	-.8833	.8248	.990
	NEW HAMPSHIRE	9.6500*	.9444	<.001
	OHIO	.5167	.8285	1.000
	TENNESSEE	10.5167*	1.0121	<.001
NEW HAMPSHIRE	ARKANSAS	-3.8167*	.5783	<.001
	CALIFORNIA	-9.7833*	.5789	<.001
	IDAHO	-9.8833*	.5672	<.001
	KANSAS	-5.3500*	.5741	<.001
	MASSACHUSETTS	-15.2333*	.5639	<.001
	MICHIGAN	-8.7833*	.6869	<.001
	MINNESOTA	-10.5333*	.5758	<.001
	NEVADA	-9.6500*	.9444	<.001
	OHIO	-9.1333*	.5811	<.001
	TENNESSEE	.8667	.8220	.992
OHIO	ARKANSAS	5.3167*	.3592	<.001
	CALIFORNIA	-.6500	.3602	.773
	IDAHO	-.7500	.3412	.515
	KANSAS	3.7833*	.3524	<.001
	MASSACHUSETTS	-6.1000*	.3355	<.001
	MICHIGAN	.3500	.5163	1.000
	MINNESOTA	-1.4000*	.3552	.009
	NEVADA	-.5167	.8285	1.000
	NEW HAMPSHIRE	9.1333*	.5811	<.001
	TENNESSEE	10.0000*	.6858	<.001
TENNESSEE	ARKANSAS	-4.6833*	.6833	<.001
	CALIFORNIA	-10.6500*	.6839	<.001
	IDAHO	-10.7500*	.6740	<.001
	KANSAS	-6.2167*	.6798	<.001
	MASSACHUSETTS	-16.1000*	.6712	<.001
	MICHIGAN	-9.6500*	.7775	<.001
	MINNESOTA	-11.4000*	.6812	<.001
	NEVADA	-10.5167*	1.0121	<.001
	NEW HAMPSHIRE	-.8667	.8220	.992

		OHIO	-10.0000*	.6858	<.001
Eye Protection Prepared	ARKANSAS	CALIFORNIA	-9.4333*	.8196	<.001
		IDAHO	-10.5167*	.7398	<.001
		KANSAS	-7.3333*	.6364	<.001
		MASSACHUSETTS	-12.6833*	.6366	<.001
		MICHIGAN	-8.4833*	.7722	<.001
		MINNESOTA	-10.9667*	.7128	<.001
		NEVADA	-9.1167*	.7077	<.001
		NEW HAMPSHIRE	-15.1500*	.7523	<.001
		OHIO	-5.9000*	.6706	<.001
		TENNESSEE	1.5833	.9289	.827
	CALIFORNIA	ARKANSAS	9.4333*	.8196	<.001
		IDAHO	-1.0833	.6731	.871
		KANSAS	2.1000*	.5573	.023
		MASSACHUSETTS	-3.2500*	.5576	<.001
		MICHIGAN	.9500	.7085	.957
		MINNESOTA	-1.5333	.6432	.397
		NEVADA	.3167	.6376	1.000
		NEW HAMPSHIRE	-5.7167*	.6868	<.001
		OHIO	3.5333*	.5962	<.001
		TENNESSEE	11.0167*	.8766	<.001
	IDAHO	ARKANSAS	10.5167*	.7398	<.001
		CALIFORNIA	1.0833	.6731	.871
		KANSAS	3.1833*	.4316	<.001
		MASSACHUSETTS	-2.1667*	.4319	<.001
		MICHIGAN	2.0333	.6144	.056
		MINNESOTA	-.4500	.5379	.999
		NEVADA	1.4000	.5311	.256
		NEW HAMPSHIRE	-4.6333*	.5893	<.001
		OHIO	4.6167*	.4807	<.001
		TENNESSEE	12.1000*	.8025	<.001
	KANSAS	ARKANSAS	7.3333*	.6364	<.001
		CALIFORNIA	-2.1000*	.5573	.023
		IDAHO	-3.1833*	.4316	<.001
		MASSACHUSETTS	-5.3500*	.2100	<.001
		MICHIGAN	-1.1500	.4849	.412
		MINNESOTA	-3.6333*	.3833	<.001
		NEVADA	-1.7833*	.3738	.001
		NEW HAMPSHIRE	-7.8167*	.4526	<.001
		OHIO	1.4333*	.2977	<.001
		TENNESSEE	8.9167*	.7083	<.001
	MASSACHUSETTS	ARKANSAS	12.6833*	.6366	<.001
		CALIFORNIA	3.2500*	.5576	<.001

	IDAHO	2.1667*	.4319	<.001
	KANSAS	5.3500*	.2100	<.001
	MICHIGAN	4.2000*	.4852	<.001
	MINNESOTA	1.7167*	.3836	.003
	NEVADA	3.5667*	.3741	<.001
	NEW HAMPSHIRE	-2.4667*	.4529	<.001
	OHIO	6.7833*	.2982	<.001
	TENNESSEE	14.2667*	.7085	<.001
MICHIGAN	ARKANSAS	8.4833*	.7722	<.001
	CALIFORNIA	-.9500	.7085	.957
	IDAHO	-2.0333	.6144	.056
	KANSAS	1.1500	.4849	.412
	MASSACHUSETTS	-4.2000*	.4852	<.001
	MINNESOTA	-2.4833*	.5816	.004
	NEVADA	-.6333	.5753	.989
	NEW HAMPSHIRE	-6.6667*	.6294	<.001
	OHIO	2.5833*	.5291	<.001
	TENNESSEE	10.0667*	.8324	<.001
MINNESOTA	ARKANSAS	10.9667*	.7128	<.001
	CALIFORNIA	1.5333	.6432	.397
	IDAHO	.4500	.5379	.999
	KANSAS	3.6333*	.3833	<.001
	MASSACHUSETTS	-1.7167*	.3836	.003
	MICHIGAN	2.4833*	.5816	.004
	NEVADA	1.8500*	.4927	.016
	NEW HAMPSHIRE	-4.1833*	.5549	<.001
	OHIO	5.0667*	.4378	<.001
	TENNESSEE	12.5500*	.7776	<.001
NEVADA	ARKANSAS	9.1167*	.7077	<.001
	CALIFORNIA	-.3167	.6376	1.000
	IDAHO	-1.4000	.5311	.256
	KANSAS	1.7833*	.3738	.001
	MASSACHUSETTS	-3.5667*	.3741	<.001
	MICHIGAN	.6333	.5753	.989
	MINNESOTA	-1.8500*	.4927	.016
	NEW HAMPSHIRE	-6.0333*	.5484	<.001
	OHIO	3.2167*	.4295	<.001
	TENNESSEE	10.7000*	.7730	<.001
NEW HAMPSHIRE	ARKANSAS	15.1500*	.7523	<.001
	CALIFORNIA	5.7167*	.6868	<.001
	IDAHO	4.6333*	.5893	<.001
	KANSAS	7.8167*	.4526	<.001
	MASSACHUSETTS	2.4667*	.4529	<.001

	MICHIGAN	6.6667*	.6294	<.001
	MINNESOTA	4.1833*	.5549	<.001
	NEVADA	6.0333*	.5484	<.001
	OHIO	9.2500*	.4997	<.001
	TENNESSEE	16.7333*	.8141	<.001
OHIO	ARKANSAS	5.9000*	.6706	<.001
	CALIFORNIA	-3.5333*	.5962	<.001
	IDAHO	-4.6167*	.4807	<.001
	KANSAS	-1.4333*	.2977	<.001
	MASSACHUSETTS	-6.7833*	.2982	<.001
	MICHIGAN	-2.5833*	.5291	<.001
	MINNESOTA	-5.0667*	.4378	<.001
	NEVADA	-3.2167*	.4295	<.001
	NEW HAMPSHIRE	-9.2500*	.4997	<.001
	TENNESSEE	7.4833*	.7392	<.001
TENNESSEE	ARKANSAS	-1.5833	.9289	.827
	CALIFORNIA	-11.0167*	.8766	<.001
	IDAHO	-12.1000*	.8025	<.001
	KANSAS	-8.9167*	.7083	<.001
	MASSACHUSETTS	-14.2667*	.7085	<.001
	MICHIGAN	-10.0667*	.8324	<.001
	MINNESOTA	-12.5500*	.7776	<.001
	NEVADA	-10.7000*	.7730	<.001
	NEW HAMPSHIRE	-16.7333*	.8141	<.001
	OHIO	-7.4833*	.7392	<.001