5-2022

Assessing Meat Processing Workers' Attitudes and Concerns Regarding COVID-19 Vaccination

Karen Schmeits
University of Nebraska Medical Center

Assessing meat processing workers' attitudes and concerns regarding COVID-19 vaccination

Karen Schmeits, Department of Health Promotion

Committee Members:

Chair: Athena Ramos, Ph.D., MBA, MS, CPM

Member 1: Dejun Su, Ph.D.

Member 2: Abigail Lowe, MA

Abstract

The COVID-19 pandemic has impacted industries across the globe. Specifically, for meat processing (meatpacking) facilities, the pandemic has changed the way facilities operate, how the workers perform tasks, and how workers perceive their health. The development of an FDA approved COVID-19 vaccine brought hope to meat processing employers and workers. However, little research has been conducted to know how meat processing workers feel about vaccines generally and how they perceive the COVID-19 vaccine. The purpose of this cross-sectional study was to investigate preventive vaccine determinants and attitudes and concerns specifically regarding the COVID-19 vaccine. Surveys were conducted with 128 meat processing workers in Nebraska from June to December 2021. Significant differences were found in certain determinants of vaccine intention, including collective responsibility and confidence, based on English proficiency levels and nativity. Nearly 90% of workers had been vaccinated for COVID-19. The primary reasons for getting vaccinated included protecting family and friends, themselves, and other coworkers. The main reasons workers provided for not getting vaccinated were lack of trust in the vaccine and potential side effects. The results from this study may help public health and health professionals better understand workers' attitudes and concerns regarding the COVID-19 vaccine, which may contribute to improved health communication and preparedness for future infectious disease outbreaks.

Chapter 1

Introduction

In December 2020, the Food and Drug Administration (FDA) gave emergency use authorization (EUA) for two COVID-19 vaccines, Pfizer-BioNTech and Moderna (Cedra & García, 2021). Although the COVID-19 vaccines are safe and effective, vaccine hesitancy remains. Vaccine hesitancy is defined as the delay in acceptance or refusal of vaccination and has been identified as one of the top ten most important and current health threats (WHO, 2019). The factors influencing individuals' decisions are complex. Such factors include environmental/external factors (e.g., media and social norms), vaccine specific factors (i.e., safety and effectiveness), and demographic characteristics (e.g., education, income, and past experiences) (Kumar et al., 2016). Researchers have assessed factors influencing decisions to receive the COVID-19 vaccine, and the top factors among the general population include trust in public health, government, or other health officials; perceived benefits and threats; interpersonal influences (e.g., family and peers); and knowledge regarding the COVID-19 vaccine (Cedra & García, 2021; Reiter et al., 2020).

In the United States, differences in vaccine hesitancy were assessed by demographic characteristics, such as race/ethnicity, education levels, and occupation. High levels of vaccine hesitancy were found among racial and ethnic minority groups (i.e., African Americans and Hispanics) (Khubchandani et al., 2021; Kumar et al., 2016; Quinn et al., 2017). In addition, those with lower income and educational attainment had higher levels of vaccine hesitancy (Khubchandani et al., 2021). In a recent study, COVID-19 vaccine hesitancy was reported highest among the construction, maintenance/repair, farming/fishing/forestry, and protective

services workforce and the lowest was among registered nurses, healthcare practitioners, and other healthcare professionals (King et al., 2021).

Alongside demographic characteristics, psychological factors play a role in vaccine intention and have been found to effectively increase vaccine uptake when utilized in interventions. Previously studied models, such as the 5 C psychological determinants of vaccination behavior, suggest that confidence (in vaccines and systems that recommend and provide vaccine), complacency (perceived threat and susceptibility of diseases), constraints (perceived barriers), calculation (assessing the pros and cons of vaccination), and collective responsibility (readiness to protect others) are important factors that influence an individual's decision to receive vaccinations (Neufeind et al., 2020; Schmid et al., 2017).

Essential workers, such as meat processing workers, have been at substantial risk of contracting the virus during the pandemic; thus, increasing the importance of increasing vaccination uptake among these workers. Meat processing employers implemented numerous preventive strategies to protect workers from contracting COVID-19, such as daily use of personal protective equipment (i.e., face masks and goggles), social distancing, and disinfecting surfaces; however, outbreaks continued. The COVID-19 vaccine(s) have become the most effective way to protect the public, including 'essential' meat processing workers. Whilst a large number of workers have received the vaccine, little is known about vaccine intention among meat processing workers or the factors influencing their decision to receive the COVID-19 vaccine and other preventive vaccines.

The purpose of this capstone project was to assess determinants of vaccine intention and understand meat processing workers' perceptions and concerns regarding COVID-19 vaccination. In order to effectively increase vaccination uptake among meat processing workers

in Nebraska, we first need to understand the factors that may be influencing workers' perception of vaccines and specifically the COVID-19 vaccine. Understanding attitudes, concerns, misconceptions, and misinformation can help better tailor public health interventions and outreach during the remainder of the COVID-19 pandemic and for future infectious disease outbreaks.

Chapter 2

Background and Literature Review

The COVID-19 pandemic has and is continuing to affect the meat processing industry in Nebraska and across the globe. The COVID-19 pandemic highlighted just how vulnerable and at risk of contracting communicable diseases meat processing workers are as well as the health inequities they face. Meat processing workers were deemed 'essential' workers because their labor is critical to the food supply in the United States (Lusk & Chandra, 2021). Their important and critical work involves the process of turning livestock into meat for human consumption and often involves repetitive motions, extended periods of standing, very hot or cold temperatures, and exposure to biological agents (i.e., influenza and staphylococcus aureus) throughout their shift (Dahms et al., 2014; Krumel & Goodrich, 2021; Rowland et al., 2021). Being an "essential worker" meant that these workers had to continue to work despite their vulnerability and considerable risk of contracting the COVID-19 virus.

Over half of the meat processing facilities in the United States are in the Midwest, and 23 of these facilities are in Nebraska. Nebraska's meat processing industry employs approximately 26,000 workers (Herstein et al., 2021). Due to close proximity with numerous other workers on the line during a shift, shared common spaces (e.g., cafeteria and locker rooms), limited personal protective equipment, and shared living spaces, meat processing facilities became an epicenter for

COVID-19 outbreaks and vectors for community transmission (Donahue et al., 2020; Taylor et al., 2020). Large outbreaks of COVID-19 occurred in nearly all meat processing facilities in the United States (Lusk & Chandra, 2021).

Meat processing facilities across the nation were disproportionally affected by high rates of infection, hospitalizations, and deaths. As of September 8, 2021, approximately 60,000 meat processing workers had contracted COVID-19 and 300 workers had died from the disease (The Food and Environment Reporting Network, 2021). According to the Nebraska Department of Health and Human Services (DHHS), as of September 6, 2021, there had been 7,401 cases, 245 hospitalizations, and 27 deaths attributed to the SARS-CoV-2 virus among individuals working in the meatpacking industry.

The unprecedented fear and stress of contracting COVID-19 in the workplace brought challenging times for meat processing employers and workers. While all employers are required to protect workers' health and safety, employers faced challenges in mitigating the risk of SARS-CoV-2 virus and many workers felt unsafe in the workplace, especially those in meat processing facilities (Ramos et al., 2020). Guidelines and recommendations to protect workers' health were given by numerous organizations, including the Centers for Disease Control and Prevention (CDC), the Occupational Safety and Health Administration (OSHA) (2020), and the Global Center for Health Security at the University of Nebraska Medical Center (2020). Despite the guidance and recommendations provided, outbreaks continued and seemed to be unavoidable.

On December 11, 2020, the Food and Drug Administration (FDA) issued the first emergency use authorization (EUA) for the use of the Pfizer-BioNTech COVID-19 vaccine (FDA, 2021a). Shortly after, on December 18, 2020, the FDA issued a second EUA for the use of the Moderna COVID-19 vaccine (FDA, 2021b). After the EUAs were issued, the CDC followed with

a vaccine priority list to help state and local health officials prepare for allocation of the COVID-19 vaccines. Because meat processing workers were at substantial risk of contracting COVID-19 and deemed ‘essential workers’, the CDC recommended prioritizing them in the 1B phase to receive the vaccine, which was among the first individuals in line (Hernandez, 2021).

Each state, however, set up their own prioritization schedule for vaccinations. In January 2021, Nebraska Governor Pete Ricketts said that legal residents would be prioritized to receive the vaccine before undocumented immigrants (Khazanchi et al., 2021); however, according to the nonpartisan Migration Policy, approximately 66% of Nebraska’s meat processing workers are immigrants, many of whom are undocumented. Ricketts’ spokesperson later stated that proof of citizenship would not be needed for vaccination. Because of the fluctuating information from government officials, some immigrant community members were fearful of getting the vaccine due to immigration-related concerns. Vaccinations for meat processing workers began at the beginning of March 2020 (Funk, 2021).

The COVID-19 vaccine became an essential and important form of protection from infection. Meat processing employers encouraged, incentivized, and mandated their workers to receive the vaccine as it was the most effective way to protect workers inside and outside the workplace. For example, Tyson Foods issued a company-wide vaccine mandate and offered $200 to frontline workers who verified they were fully vaccinated (Hirsch, 2021). In addition, workers were provided with information on the importance of vaccination as well as locations of vaccine clinics. As of April 7, 2022, approximately 68% of individuals in Nebraska were fully vaccinated against COVID-19 (Nebraska DHHS, 2021).

Chapter 3

Data and Methods

The purpose of the overall research study, led by the University of Nebraska Medical Center's Center for Reducing Health Disparities team, was to assess and analyze meat processing workers' attitudes, perceptions, and workplace experiences associated with COVID-19 exposures, prevention, and treatment. The study consisted of two parts: a survey and a series of qualitative interviews. It was led by Dr. Athena Ramos and approved by the UNMC Institutional Review Board, IRB #921-20-EX. The purpose of my project is to extend the quantitative analysis to assess determinants of vaccine intention among meat processing workers and better understand their perceptions and concerns regarding the COVID-19 vaccine.

I hypothesized the following:

H1: Determinants of vaccine intention, including confidence, constraints, and calculation, will significantly differ between workers based on English proficiency and nativity (U.S.-born vs. foreign-born).

H2: There will be a positive relationship between meat processing worker's COVID-19 vaccination status and confidence, collective responsibility, calculation, nativity, having received an annual flu shot, membership in local workers' union, and English proficiency. There will be a negative relationship between worker's COVID-19 vaccination status with complacency and constraints.

Participants and Procedures

Inclusion criteria to take part in the study included being at least 19 years of age or older and being currently employed in an animal slaughter or meat processing (meatpacking) facility. Participation in the study was promoted through social networks, relationships with community organizations, and direct recruitment by the research team members at community events. Study data was collected and managed using REDCap (Research Electronic Data Capture), a secure, web-based application designed to support data capture for research studies, which is supported by the Research IT Office and funded by the Vice Chancellor for Research. The survey was available on REDCap but was administered through verbal interviews with workers. Workers had the option to complete the survey in English or Spanish. Workers who completed the survey were compensated with a $10 VISA gift card. Surveys were conducted beginning in June 2021, and as of December 2021, a total of 128 Nebraska workers had completed the survey.

Measures

Psychological determinants of vaccine intention

The 5C psychological antecedents of vaccine intention by Betsch et al. (2018) is a valid and reliable measure that assesses five psychological antecedents that determine vaccine behaviors (e.g., confidence, collective responsibility, constraints, complacency, and calculation) and was used in the survey. The six questions included:

1. I am confident that vaccines are safe. (confidence)
2. Vaccines have many known harmful side effects. (constraint[1])
3. Vaccines provide important benefits to society. (collective responsibility)
4. Vaccines may lead to illness and death. (constraint[2])

5. When I think about getting vaccinated, I weigh the benefits and risks to make the best decision possible. (calculation)
6. When everyone is vaccinated, I don't have to get vaccinated too. (complacency)

Participants were asked how much they agreed or disagreed with each statement. Response options included completely disagree (0), somewhat disagree (1), neutral (2), somewhat agree (3), and completely agree (4).

COVID-19 Experiences

Participants were asked about their experiences with the COVID-19 vaccines including if they have been vaccinated (yes (1)/no (0)). If participants had been vaccinated, they were asked about their top three reasons for becoming vaccinated and the locations where they received the vaccine. If participants had not been vaccinated, they were asked their top three reasons for choosing not to be vaccinated. All participants were also asked their top three trusted sources of information regarding the COVID-19 vaccines (i.e., CDC, healthcare providers, employer, local public health department), their level of trust in public health agencies that recommend they become vaccinated against COVID-19, and if they had received the annual flu shot between September 2020 and December 2021.

Demographic Characteristics

Basic demographic information was collected from participants. Gender was coded male (0), female (1), and non-binary (2). Participants were asked about their race/ethnicity with response options including White (0), Black/African American/Black Diaspora/Afro-Descendent (1), Asian/Pacific Islander (2), Hispanic/Latino/Spanish origin (3), Native American/American Indian (4), Other Indigenous (e.g., Maya, Zapotec, Mixtec, etc.) (5), Arabic/Middle Eastern (6),

and some other race (7). English proficiency was assessed through the question, "How well do you speak English?". Responses were originally coded as not at all (0), not well (1), well (2), and very well (3), but were later recoded into two categories representing English proficient (combing "well" and "very well") (0) and limited English proficient (combining "not at all" and "not well") (1). Participants were asked where they were born, and responses were coded into U.S. born (0) and foreign-born (1). Age, duration of employment in meatpacking, tenure with current meatpacking employer, years of school completed, and length of time in the United States were coded as continuous variables. If participants specified time in months, the number was converted into years. Work department was coded as: Kill floor/harvesting (0), fabrication (1), maintenance (2), administration (3), and other (4).

Data Analytic Plan

The quantitative data for this project was analyzed using IBM SPSS version 27.0 software. First, descriptive statistics were used to provide the number of valid responses, frequency, mean, and standard deviation for demographic variables of interest. A Mann-Whitney U test was conducted to assess the differences in determinants of vaccine intention by English proficiency and nativity (i.e., U.S.-born vs. foreign-born). This test was used because the data was not normally distributed, and the population means are unequal. The Mann-Whitney U test reports the sample sizes of each group, the significance level (*p*, one-sided tail; z, two-sided tail), the value of U (difference between the two rank totals), and the mean rank (median of total participants responses) (Dehaena et al., 2021).

Lastly, Pearson's correlation coefficients were used to test the correlations between meat processing worker's COVID-19 vaccination status, having received an annual flu shot, psychological determinants of vaccine intention, nativity, membership in local workers' union,

and English proficiency. Pearson's correlation coefficient is a common and effective way to measure the direction and strength of relationships between two quantitative variables (Geert, 2020).

Chapter 4

Results

A total of 128 meatpacking workers from Nebraska participated in the study. Of the total, 74 (58.3%) were female, 115 (898.8%) were Hispanic/Latino/Spanish origin, and 114 (89.9%) were foreign-born. The mean age of participants was 45.87 (SD=13.08). Additional demographic characteristics of the study population can be found in Table 1.

Table 1

Demographic characteristics of participating meatpacking workers

Demographic	n	%	Mean (S.D.)
Gender	127		
Male	53	41.7	
Female	74	58.3	
Ethnicity			
Hispanic/Latino/Spanish Origin	115	89.8	
White	11	8.6	
Other Indigenous (e.g., Maya, Zapotec, Mixtec, etc.)	6	1.6	
African American/Black Diaspora/Afro-Descendent	3	2.3	
Some other race	2	1.6	
Age	125		45.87 (13.08)
<25	9	7.2	
26-40	38	30.4	

41-55	44	35.2	
>56	34	27.2	
Household Total Annual Income	122		
Less than $24,999	8	6.6	
$25,000 to $34,999	17	13.9	
$35,000 to $44,999	28	23	
$45,000 to $59,999	28	23	
$60,000 to $74,999	29	23.8	
$75,000 to $89,999	7	5.7	
$90,000 to $164,999	5	4.1	
English proficiency	127		
English Proficient	49	38.5	
Limited English Proficient	78	61.4	
Length of time in the United States (in years)	113		20.39 (12.12)
Years of school completed (in years)	128		9.14 (4.67)
Country of Origin	127		
U.S. Born	13	10.2	
Foreign-born	114	89.8	
Work department	127		
Fabrication	77	60.6	
Kill floor/harvesting	36	28.3	
Other	9	7.1	
Maintenance	3	2.4	
Administration	2	1.6	
Received a flu shot since September 2020	90	70.9	
Tenure with current meatpacking employer (in years)	125		11.23 (9.34)
Member of the local workers union	67	46.8	

Determinants of Vaccine Intention

Determinants of Vaccine Intention by English Proficiency

The Mann-Whitney U test indicated that there were significant differences in two determinants of vaccine intention: confidence and collective responsibility. Significant differences were present for the item, “I am confident that vaccines are safe” (p=.026). Participants with limited English proficiency had a higher mean rank (69.49) than participants who were English proficient (55.27) on that item. Significant differences were also present for the item, “When everyone is vaccinated, I don’t have to get vaccinated too” (p=.005). Participants who were English proficient had a significantly higher mean rank (74.72) than those with limited English proficiency (57.26) (Table 2).

Table 2

Determinants of vaccine intention by English proficiency

Variable	English Proficiency	N	Mean Rank	U	Z	*p*
1. I am confident that vaccines are safe. *	Proficient	49	55.27	2339	2.226	.026
	Limited	78	69.49			
2. Vaccines have many known harmful side effects.	Proficient	48	69.81	1569	-1.576	.115
	Limited	78	59.62			
3. Vaccines provide important benefits to society.	Proficient	48	57.32	2168.5	1.681	.093
	Limited	78	67.30			
4. Vaccines may lead to illness and death.	Proficient	49	67.00	1764	-.756	.450
	Limited	78	62.12			
5. When I think about getting vaccinated, I weigh the benefits and risk to make the best decision possible.	Proficient	49	66.20	1754	-.690	.490
	Limited	77	61.78			
6. When everyone is vaccinated, I don't have to get vaccinated too. *	Proficient	49	74.72	1385.5	-2.803	.005
	Limited	78	57.26			

*$p < .005$

Determinants of Vaccine Intention by Nativity (U.S.-born vs. Foreign-born)

Only one determinant of vaccine intention, "Vaccines may lead to illness and death", showed significant differences based on nativity (p=.005) (Table 3). Participants who were U.S. born had a higher mean rank (90.43) than participants who were foreign-born (60.99).

Table 3

Determinants of vaccine intention by nativity

Variable	Nativity	N	Mean Rank	U	Z	*p*
1. I am confident that vaccines are safe.	U.S. born	13	61.69	771	.251	.802
	Foreign born	114	64.26			
2. Vaccines have many known harmful side effects.	U.S. born	12	66.04	653.5	-.262	.793
	Foreign born	114	63.23			
3. Vaccines provide important benefits to society.	U.S. born	12	60.21	723.5	.370	.711
	Foreign born	114	63.85			
4. Vaccines may lead to illness and death. *	U.S. born	13	90.43	397.5	2.838	.005
	Foreign born	114	60.99			
5. When I think about getting vaccinated, I weigh the benefits and risks to make the best decision possible.	U.S. born	13	64.12	726.5	-.067	.947
	Foreign born	144	63.43			
6. When everyone is vaccinated, I don't have to get vaccinated too.	U.S. born	13	76.46	579	-1.388	.165
	Foreign born	114	62.58			

*$p < .005$

COVID-19 Experiences

Out of the 128 participants, 114 (89.8%) had received the COVID-19 vaccine, and of those, 96 (84.2%) received the vaccine at their workplace (Table 4).

Table 4

Meatpacking workers' experiences with COVID-19 vaccination

COVID-19 Vaccination Experiences	N (%)
Have been vaccinated for the coronavirus (COVID-19) (N=127)	114 (89.8)
Location where the COVID-19 vaccine was obtained (N=114)	
Workplace	96 (84.2)
Hospital, healthcare clinic, or doctor's office	8 (7.0)
Mass vaccination clinic in the community	6 (5.3)
Local Pharmacy	3 (2.6)
Other	1 (0.9)
Trust in public health agencies to recommend the COVID-19 vaccine (N=127)	
Not at all	4 (3.1)
A little	25 (19.7)
Moderately	38 (29.9)
Very much	60 (47.2)

The top three reasons participants chose to get vaccinated were: (1) to protect their friends and family (85.2%); (2) to protect themselves (83.6%); and (3) to protect their coworkers (71.9%) (Figure 1). Among those who had not been vaccinated, the top three reasons for not getting vaccinated included: (1) lack of trust in the COVID-19 (53.9%) (2) side effects (53.9%); and (3) other (38.5%) (Figure 2). The top three sources of information regarding the COVID-19

vaccine were: (1) Centers for Disease Control and Prevention (71.1%); (2) healthcare providers (46.1%); and (3) the state health department (40.6%) (Figure 3).

Figure 1

Reasons meat processing workers had gotten the COVID-19 vaccine

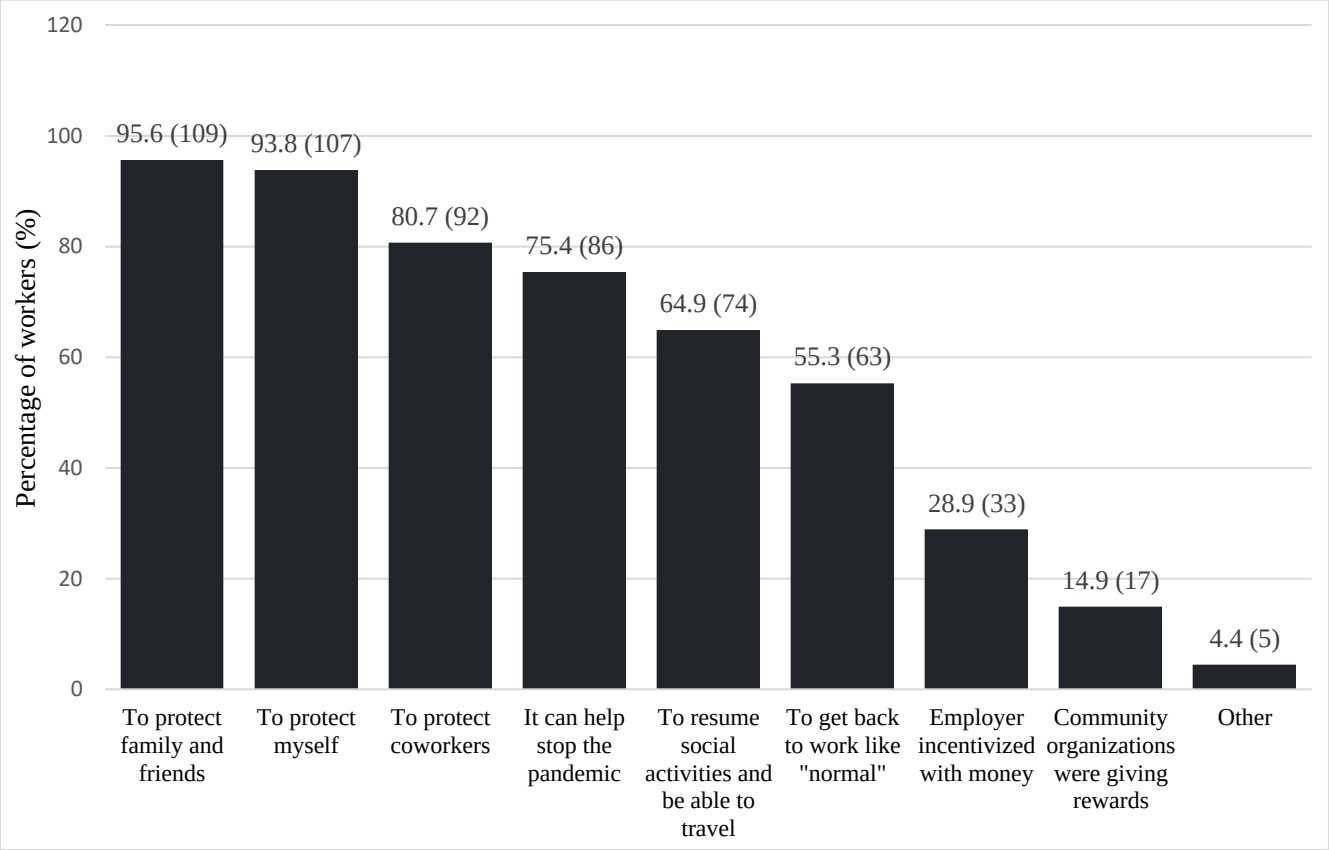


Figure 2

Reasons meat processing workers had not gotten the COVID-19 vaccine

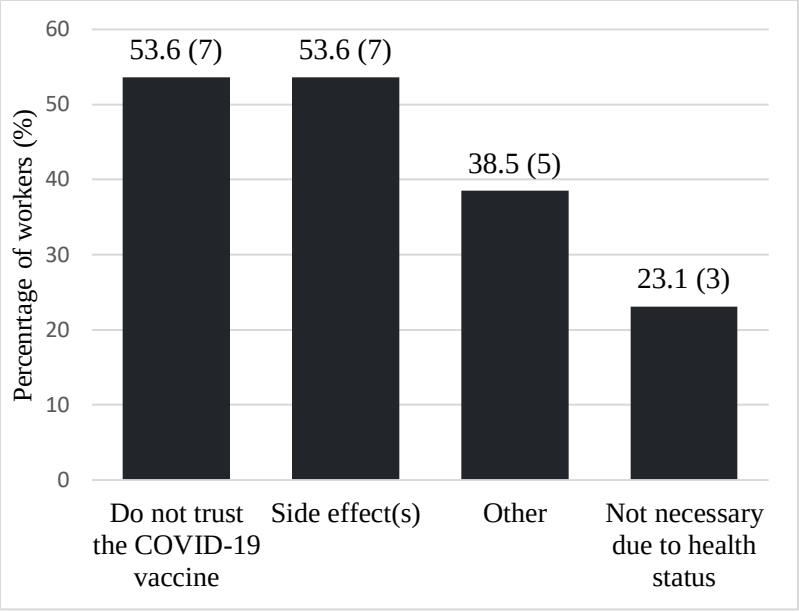
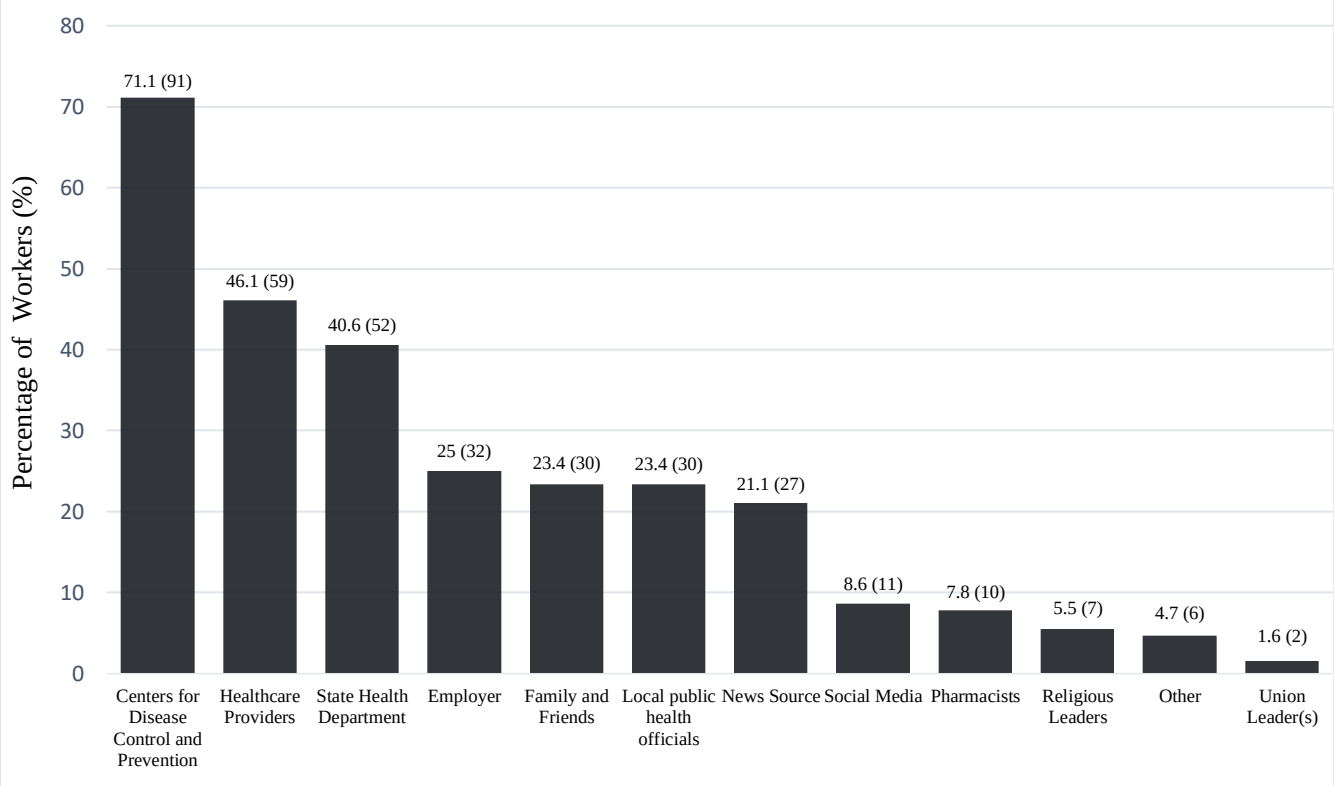


Figure 3

Trusted sources of information about the COVID-19 vaccine among meat processing workers



Correlational Analyses

Participants' COVID-19 vaccination status was positively correlated flu shot status (r=.256; p=.006), confidence (r=319; p<.001), and collective responsibility (r=254; p=.004). Participants' COVID-19 vaccination status was negatively correlated with constraint[1] (r=-.196; p=.028), and complacency (r=-.306; p<001).

Participants' flu shot status was positively correlated with confidence (r=.239; p=.007) and nativity (r=.317; p<.001). Participant's flu shot status was negatively correlated with constraints[2] (r=-.237; p=.007) and complacency (r=-.289; p<.001).

More correlations can be found in Table 5.

Table 5

Correlation between COVID-19 vaccination status, flu shot status, psychological determinants of vaccine intention, nativity, English proficiency, and membership in local worker union

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Fully vaccinated for COVID-19	1.00										
2. Flu shot status	.256**										
3. Confidence	.319**	.239**									
4. Constraints[1]	-.196*	-.114	-.368**								
5. Collective responsibility	.254**	.142	.581**	-.315**							
6. Constraints[2]	-.150	-.237**	-.382**	.494**	-.352**						
7. Calculation	.000	-.149	-.030	.252**	-.033	.278**					
8. Complacency	-.306**	-.289**	-.409**	.355**	-.399**	.208*	.109				
9. Nativity	.145	.317**	.091	-.112	.051	-.269**	-.108	-.080			
10. English Proficiency	.096	-.047	-.079	.004	-.092	-.083	.039	.122	-.132		
11. Union membership	-.102	-.080	.004	.045	-.105	-.068	.022	-.014	-.079	-.119	1.00

*p<.01**, p<05

Chapter 5

Discussion

This study sought to assess determinants of vaccine intention among meat processing workers as well as attitudes and concerns towards the COVID-19 vaccine. From this study, we were able to develop a better understanding vaccine intention among meat processing workers, factors influencing workers' decision to receive the COVID-19 vaccination, and trust in public health and healthcare professionals. The results from this study highlight valuable information for public health practitioners to effectively improve and tailor messages to protect workers and increase vaccination uptake during the remainder of the COVID-19 pandemic and for any future infectious disease outbreaks.

This study found significant differences in multiple determinants of vaccine intention between workers who were English proficient and those with limited English proficiency, which is consistent with the hypothesis. The two items with significant differences were “I am confident that vaccines are safe” (signifying confidence) and “When everyone is vaccinated, I don’t have to get vaccinated too” (signifying complacency). Workers with limited English proficiency had a higher mean rank for “I am confident that vaccines are safe” and workers who were English proficient had a higher mean rank for “When everyone is vaccinated, I don’t have to get vaccinated too”. These differences may suggest that vaccine intention may be influenced by factors such as cultural beliefs or cultural differences, vaccine advice from household members, and psychosocial factors (e.g., religious beliefs and personality characteristics) (Browne et al., 2015; Taylor et al., 2017).

There was a significant difference in one determinant of vaccine intention among foreign-born and U.S.-born workers: “Vaccines may lead to illness and death” (signifying constraints), which was partially consistent with the hypothesis. Workers who were born in the U.S. had a higher mean rank, suggesting they agree more strongly with the statement than workers who are foreign-born. Recent studies have found foreign-born individuals to be less supportive of preventive vaccines, such as influenza and human papillomavirus (HPV) (Tsui et al., 2021; Jang & Kang, 2021). Since a majority of Nebraska’s meat processing workers are immigrants coming from various places around the globe (Migration Policy Institute, 2020), it is important to consider and respect the diverse cultural backgrounds when promoting preventive vaccinations through messaging, interventions, and policies.

Developing a better understanding the factors associated with meat processing workers’ intention to vaccinate allows us to develop strategies to increase vaccination uptake. The 5C model suggests there are five psychological determinants of vaccination intention: confidence, complacency, constraints, calculation, and collective responsibility (Bestch et al., 2018; Neufiend et al., 2020). The concepts from the 5C model can be utilized to address multiple factors influencing meat processing workers decision to get vaccinated. The primary determinants of vaccine intention that may be addressed among participants included confidence, constraints, and collective responsibility. Such may involve using a trusted messenger (i.e., employer or community member) to improve workers’ trust in the health systems, address the common barriers to receiving vaccination, and educate on the responsibility and duty to become vaccinated to protect themselves and the public (AuYoung et al., 2022)

We found that most meat processing workers had received the COVID-19 vaccine (89.9%) and the majority (84.2%) received the COVID-19 vaccine at their workplace.

Behavioral science has identified an enabling environment as the main driver to vaccination uptake (World Health Organization, 2020). Environmental factors include location, cost, time, and health regulations (i.e., mandatory vaccinations for employed). Specifically with COVID-19 vaccination, the availability of appointments and proximity of vaccination clinics are factors that if addressed appropriately can be an effective way to increase vaccination uptake (Luthy et al., 2016; Riva et al., 2021).

The top three reasons participants chose to receive the COVID-19 vaccine were: to protect family and friends (85.2%); to protect themselves (83.6%); and to protect my co-workers (71.9%). The main reason the participants had not received the COVID-19 vaccine was due to lack of trust in the COVID-19 vaccine (53.8%) and the side effects (53.8%). This is consistent with a recent study assessing factors influencing the general public's decision to become vaccinated against COVID-19. The study found that the main factors leading individuals to become vaccinated was to protect themselves and their families. In addition, top reasons individuals delay or refuse COVID-19 vaccination was due to the side effects and the lack of knowledge about vaccines (Cedra & García, 2021). Understanding factors influencing meat processing workers' decisions may allow for improved tailoring of health information to address misconceptions and misinformation (Brunson & Schoch-Spana, 2020).

Participants exhibited high levels of trust in public health agencies as well as other health professionals, such as healthcare providers and state health departments, to provide credible information regarding the COVID-19 vaccine. Nearly half (47.2%) of participants stated they trusted public health agencies that recommended getting the COVID-19 vaccine very much, and 29.9% stated they had moderate trust. The top three most trusted sources of information for workers were: Centers for Disease Control and Prevention (71.1%), healthcare providers

(46.1%), and state health department (40.6%). The pandemic highlighted the crucial leadership roles that public health and health professionals play in providing the public with guidance and recommendations to remain safe and healthy. Trust in health professionals plays a vital role in effectively relaying information and recommending strategies to protect health (Antinyan et al., 2021).

Certain psychological determinants were found be to significantly correlated with COVID-19 vaccination and flu vaccinations among meat processing workers. First, COVID-19 vaccination was positively correlated with confidence and collective responsibility, yet negatively correlated with constraints[1] and complacency. Flu vaccination was positively correlated with confidence and negatively correlated with complacency and constraints[2]. This may suggest that vaccine intention is different based on the vaccine being received and using psychological determinants associated with one vaccine, such as COVID-19 vaccine, may not provide sufficient information to effectively increase vaccination uptake among all vaccines (Betsch et al., 2018). Addressing each psychological determinant is important for vaccination uptake among meat processing workers; however, assessing the psychological determinants for specific vaccines can increase effectiveness and reach.

Meat processing workers are at an increased risk of contracting communicable and infectious diseases due to social and workplace conditions (Krumel & Goodrich, 2021). Despite being deemed “essential workers” during the pandemic, federal agencies failed to recognize their risk and effectively protect their health (Lowe, et al., 2021). Individual states also failed to vaccinate meat processing workers when other essential workers were, such as healthcare workers. The health and social disparities faced by meat processing workers are not new. They were merely illuminated during the COVID-19 pandemic and have contributed to COVID-19

infection among workers and increased their risk for negative health outcomes and death (Dineen, 2020; Lowe et al., 2021).

Honoring the core values of public health means acknowledging and addressing the social injustices and challenges meat processing workers have and continue to face. To achieve high and equitable vaccination uptake, public health authorities and communities may consider using existing scientific knowledge on effective strategies, tailoring messaging to workers with diverse backgrounds (e.g., health information in multiple languages, addressing common concerns such as side effects), providing onsite vaccination clinics to accommodate to workers' schedules and other barriers, providing paid time off for possible side effects (e.g., sore arm or fatigue) resulting from vaccination, creating a safe place for questions and concerns to be voiced, and continually improving workers' trust in public health and health professionals. Promoting equity and addressing concerns in the animal slaughter or meat processing industry may help to ensure that workers' health is protected, such as understanding the perspectives of workers in developing relevant strategies and interventions (Evagora-Campbell et al., 2022; Lowe et al., 2022).

The limitations of this study include the use of self-reported data directly from participants. Meat processing workers may have feared that their experience or participation in the study could negatively impact their employment situation, and therefore, some workers may have been hesitant to participate. This led to a limited sample size, which may have influenced the associations identified in the results. There were significant differences in the number of participants with limited English proficiency and those who were English proficient; those who were fully vaccinated for COVID-19 and those who were not; and foreign-born and U.S. born individuals. A

larger and more equal sample size would have allowed us to discuss the relationships more confidently between these variables.

Conclusion

The meat processing and packing industry employs more than 500,000 workers nationally and approximately 26,000 workers in Nebraska (Herstein et al., 2021; IBIS World, 2021). Without proper safety and protection against infectious diseases, meat processing workers remain at high risk for illness and death; thus, limiting their ability to meet the supply and demand for meat products in the United States and globally. Advancing equitable workplace conditions for meat processing workers begins by understanding the work context and conditions. This study sought to understand experiences, attitudes, and concerns with COVID-19 vaccination and additional preventive vaccines to more effectively protect essential meat processing workers and promote public health messaging and outreach agenda that is based on the lived experiences of workers.

Future research may consider assessing COVID-19 vaccine confidence, factors influencing decisions to become vaccinated, and trust in public health and health professionals among a larger sample of meat processing workers across the United States that is more representative of the meat processing workforce. Future studies may also consider developing a better understanding of the strategies meat processing employers implemented to increase vaccination uptake among their workers. Understanding meat processing workers perceptions of vaccination and factors influencing their decisions across the United States may allow public health and health professionals to better serve and protect the health of essential workers. The COVID-19 pandemic is a chance to reflect on strategies that worked and those that did not work in order to better prepare for future infectious disease outbreaks.

Literature Cited

Antinyan, A., Bassetti, T., Corazzini, L., & Pavesi, F. (2021, July). Trust in health systems and COVID-19 treatment. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.643758

AuYoung, M., Espinosa, P. R., Chen, W., Juturu, P., Young, M. T., Casillas, A., Adkins-Jackson, P., Hopfer, S., Kissam, E., Kawaiopua, A., Vargas, R. A., Brown, A. R., & STOP COVID-19 C.A. Communications Working Group. (2022). Addressing racial/ethnic inequalities in vaccine hesitancy and uptake: Lessons learned from the California alliance against COVID-19. *Journal of Behavioral Medicine*, 1-14. https://doi.org/10.1007/s10865-022-00284-8

Betsch, C., Schmid, P., Heinemeier, D., Korn, L., Holtmann, C., & Böhm R. (2018). Beyond confidence: Development of a measure assessing the 5C psychological antecedents of vaccination. *PLoS ONE*, *13*(12), e0208601. https://doi.org/10.1371/journal.pone.0208601

Brunson, E. K. & Schoch-Spana, M. (2020). A social and behavioral research agenda to facilitate COVID-19 vaccine uptake in the United States. *Health Security*, *18*(4), 338–344. https://doi.org/10.1089/hs.2020.0106

Center for Disease Control and Prevention. (2021). Building trust in COVID-19 vaccine. *Center for Disease Control and Prevention: Vaccines and Immunizations.* Retrieved from: https://www.cdc.gov/vaccines/covid-19/vaccinate-with-confidence/building-trust.html

Cerda, A. A., & García, L.Y. (2021). Hesitation and refusal factors in individuals' decision-making processes regarding a coronavirus disease 2019 vaccination. *Frontiers in Public Health*, *9*. https://doi.org/10.3389/fpubh.2021.626852

Dauhms, C., Hübner, N. O., Wilke, F., & Kramer, A. (2014). Mini-review: Epidemiology and zoonotic potential of multiresistant bacteria and Clostridium difficile in livestock and food. *GMS Hygiene and Infection Control*, *9*(3). https://dx.doi.org/10.3205%2Fdgkh000241

Dehaene, H., Neve, J. D., & Rosseel, Y. (2021). A Wilcoxon-Mann-Whitney test for latent variables. *Frontiers in Psychology, 12*, 754989. https://doi.org/10.3389/fpsyg.2021.754898

Dineen, K. K. (2020). Meat processing workers and the COVID-19 pandemic: The subrogation of people, public health, and ethics to profits and a path forward. *Saint Louis University Journal of Health Law & Policy, 14*. Retrieved from https://scholarship.law.slu.edu/jhlp/vol14/iss1/4

Donahue, M., Sreenivasan, N., Stover, D., Rajasingham, A., Watson, J., Bealle, A., Ritchison, N., Safranek, T., Waltenburg, M. A., Buss, B., & Reefhuis, J. (2020). Notes from the field: Characteristics of meat processing facility workers with confirmed SARS-CoV-2 infection – Nebraska. *Morbidity and Mortality Weekly Report*, *69*(31), 1020–1022. http://dx.doi.org/10.15585/mmwr.mm6931a3external icon

Evagora-Campbell, M., Zahidie, A., Buse, K., Rabbani, F., & Hawkes, S. (2022). Promoting labour migrant health equity through action on the structural determinants: A systematic review. *Journal of Migration and Health*, *5*. https://doi.org/10.1016/j.jmh.2022.100082

FDA. (2021a). Comirnaty and Pfizer-BioNTech COVID-19 vaccine. *U.S. Food and Drug Administration*. Retrieved from https://www.fda.gov/emergency-preparedness-and-

response/coronavirus-disease-2019-covid-19/comirnaty-and-pfizer-biontech-covid-19-vaccine.

FDA. (2021b). Moderna Covid-19 vaccine. *U.S. Food and Drug Administration*. Retrieved from https://www.fda.gov/emergency-preparedness-and-response/coronavirus-disease-2019-covid-19/moderna-covid-19-vaccine.

Funk, J. (2021). Thousands of meatpacking workers to be vaccinated this week. *Lincoln Journal Star*. Retrieved from https://journalstar.com/business/local/thousands-of-meatpacking-workers-to-be-vaccinated-this-week/article_276a6cae-8f4e-52a7-8ae4-c1cbd4ece3f5.html.

Geert, R. (2020). Pearson correlations – Quick introduction. Retrieved from https://www.spss-tutorials.com/pearson-correlation-coefficient/

Global Center for Health Security & Center States for Agricultural Health and Safety. (2020). Meat processing facility COVID-19 playbook. Retrieved from https://www.unmc.edu/healthsecurity/covid-19/meatprocessing/Meat-Processing-Playbook-Final.pdf

Hernandez, F. (2021). The CDC recommended states prioritize farm workers for the COVID-19 vaccine. Some large agricultural states have not. *The Counter*. Retrieved from https://thecounter.org/cdc-farm-workers-texas-florida-covid-19-vaccine/

Herstein, J. J., Degarege, A., Stover, D., Austin, C., Schwedhelm, M. M., Lawler, J. V., Lowe, J. J., Ramos, A. K., & Donahue, M. (2021). Characteristics of SARS-CoV-2 transmission among meat processing workers in Nebraska, USA, and effectiveness of risk mitigation

measures. *Emerging Infectious Diseases*, *27*(4), 1032–1038. https://doi.org/10.3201/eid2704.204800

Hirsch, L. (2021). Tyson Foods mandates vaccines for its U.S. work force. *The New York Times.* Retrieved from https://www.nytimes.com/2021/08/03/business/tyson-vaccine-mandate.html

IBIS World (2021). Meat, beef, & poultry processing in the United States – Employment statistics 2005-2027. Retrieved from https://www.ibisworld.com/industry-statistics/employment/meat-beef-poultry-processing-united-states/

Ijaz, M., Yar, M. K., Badar, I. H., Ali, S., Islam, M. S., Jaspal, M. H., Hayat, Z., Sardar, A., Ullah, S., & Guevara-Ruiz, D. (2021). Meat production and supply chain under covid-19 scenario: Current trends and future prospects. *Frontiers in Veterinary Science, 8*, 660736. https://doi.org/10.3389/fvets.2021.660736

Jang, S. H. & Kang, J. (2021). Factors associated with Influenza vaccination uptake among U.S. adults: Focus on Nativity and Race/Ethnicity. *International Journal of Environmental Research and Public Health, 18*(10), 5349. https://doi.org/10.3390/ijerph18105349

Khazanchi, R., Ramos, A. K., De Alba, A., & Marcelin, J. (2021). Vaccine prioritization should be based on science and safety. *U.S. News & World Report.* Retrieved from https://www.usnews.com/news/best-states/articles/2021-01-15/vaccine-prioritization-should-be-based-on-science-and-safety-not-immigration-status

Khubchandani, J., Sharma, S., Price, J. H., Wiblishauser, M. J., Sharma, M., & Webb, F. J. (2021). COVID-19 vaccination hesitancy in the United States: a rapid national

assessment. *Journal of Community Health*, *46*(2), 270–277. https://doi.org/10.1007/s10900-020-00958-x

King, C. W., Rubinstein, M., Reinhart, A., & Mejia, R. (2021). COVID-19 vaccine hesitancy January-May 2021 among 18-64 year old US Adults by employment and occupation. *Preventative Medicine Report, 24*, 101569. https://doi.org/10.1016/j.pmedr.2021.101569

Krumel, T. P. & Goodrich, C. (2021, September). Covid-19 working paper: Meatpacking working conditions and the spread of COVID-19. *USDA Economic Research Service. #AP-092.* Retrieved from https://www.ers.usda.gov/webdocs/publications/102206/ap-092.pdf?v=7934.3

Kumar, D., Chandra, R., Mathur, M., Samdariya, S., & Kapoor, N. (2016). Vaccine hesitancy: Understanding better to address better. *Journal of Health Policy and Research*, *5*(2). https://doi.org/10.1186/s13584-016-0062-y

Lowe, A. E., Dineen, K. K., & Mohapatra, S. (2022). Structural discrimination in pandemic policy: Essential protections for essential workers. The *Journal of Law, Medicine, & Ethics*, *50*, 67-76. https://doi.org/10.1017/jme.2022.10

Lusk, J. L. & Chandra, R. (2021) Farmer and farm worker illnesses and deaths from COVID-19 and impacts on agricultural output. *PloS ONE, 16*(4), e0250621. https://doi.org/10.1371/journal.pone.0250621

Luthy, K. E., Bainum, J. L., Beckstrand, R. L., Macintosh, J. L. B., Eden, L. M., Saunders, B. (2016). Promoting adult Pertussis vaccination in the workplace. *Workplace Health & Safety*, *64*(6), 269-278. https://doi.org/10.1177/2165079916628883

Migration Policy Institute (2020) The essential role of immigrants in the U.S. Food Supply Chain. Retrieved from https://www.migrationpolicy.org/content/essential-role-immigrants-us-food-supply-chain

National Agricultural Statistics Service, Agricultural Statistics Board, & United States Department of Agriculture. (2021). Livestock slaughter. *United States Department of Agriculture (USDA)*. Retrieved from https://downloads.usda.library.cornell.edu/usda-esmis/files/rx913p88g/sx61fm71b/pr76g4549/lstk1121.pdf

Nebraska Department of Health and Human Services. (2021). Nebraska hospital capacity & respiratory illness dashboard: COVID-19 workbook. Retrieved from https://datanexus-dhhs.ne.gov/views/Covid/1_DailyCharts?%3AisGuestRedirectFromVizportal=y&%3Aembed=y

Neufiend, J., Betsch, C., Habetsaat, K. B., Eckardt, M., Schmid, P., & Wichmann, O. (2020). Barriers and drivers to adult vaccination among family physicians – Insights for tailoring immunization program in Germany. *Vaccine, 38*(27), 4252-4262 https://doi.org/10.1016/j.vaccine.2020.04.052

Occupational Safety and Health. (2020). Guidance on preparing workplace for COVID-19. Retrieved from https://www.osha.gov/sites/default/files/publications/OSHA3990.pdf

Quinn, S. C., Jamison, A., Freimuth, V. S., An, J., Hancock, G. R., & Musa, D. (2017). Exploring racial influences on flu vaccine attitudes and behavior: Results of a national survey of White and African American adults. *Vaccine*, *35*(8), 1167-1174. https://doi.org/10.1016/j.vaccine.2016.12.046

Ramos, A. K., Lowe, A., Herstein, J. J., Trinidad, N., Carvajal-Suarez, M., Quintero, S. A., Molina, D., Schwedhelm, S., & Lowe, J. J. (2021). A rapid-response survey of essential workers in Midwestern meatpacking plants: Perspectives on COVID-19 response in the workplace. *Journal of Environmental Health*, *84*(1), 16-25.

Ramos, A. K., Lowe, A. E., Herstein J. J., Schwedhelm, S., Dineen, K. K. & Lowe, J. J. (2020). Invisible no more: The impact of COVID-19 on essential food production workers. *Journal of Agromedicine, 25*(4), 378-382. https://doi.org/10.1080/1059924X.2020.1814925

Reiter, P. L., Pennell, M. L., & Katz, M. L. (2020). Acceptability of a COVID-19 vaccine among adults in the United States: How many people would get vaccinated? *Vaccine, 38*(42), 6500–6507. https://doi.org/10.1016/j.vaccine.2020.08.043

Riva, M. A., Paladino, M. E., Paleari, A., & Belingheri, M. (2021). Workplace COVID-19 vaccination, challenges, and opportunities. *Occupational Medicine.* https://doi.org/10.1093/occmed/kqab080

Rowland, S.A., Ramos, A.K., Carvajal-Suarez, M., Trinidad, N., Johnson-Beller, R., Struwe, L., Quintero, S., & Pozehl, B. (2021). Musculoskeletal pain and cardiovascular risk in Hispanic/Latino meatpacking workers. *Workplace Health & Safety*, *69*(12). https://doi.org/10.1177/21650799211016908

Schmid, P., Rauber, D., Betsch, C., Lidolt, G., & Denker M. L. (2017). Barriers of Influenza vaccination intention and behavior – A systematic review of Influenza vaccine hesitancy, 2005-2016. *PLoS ONE,* 12(1), e0170050. https://doi.org/10.1371/journal.pone.0170550

Taylor, C., Boulos, C., & Almond, D. (2020). Livestock plants and COVID-19 transmission. *The Proceeding of the National Academy of Science, 117*(50), 31706-31715. https://doi.org/10.1073/pnas.2010115117

Taylor, E., Atkins, K. E., Medlock, J., Li, M., Chapman, G., & Galvani, A. P. (2017). Cross-cultural household influences on vaccination decisions. *An International Journal of the Society for Medical Decision Making, 36*(7), 844-853. https://doi.org/10.1177/0272989X15591007

The Food and Environment Reporting Network (FERN). (April 2020). Mapping COVID-19 outbreaks in the food system. (Updated September 8, 2021). Retrieved from: https://thefern.org/2020/04/mapping-covid-19-in-meat-and-food-processing-plants/

Tsui, J., Martinez, B., Shin, M. B., Munoz-Alec, A., Rodriguez, I., Navarro, J., Thomas-Barrios, K. R., Kast, W. M., & Baezconde-Garbanati, L. (2021). Understanding medical mistrust and HPV vaccine hesitancy among multiethnic parents in Los Angeles. *Journal of Behavioral Medicine*, 1-16. https://doi.org/10.1007/s10865-022-00283-9

World Health Organization. (2019). Ten threats to global health in 2019. *World Health Organization.* Retrieved from https://www.who.int/news-room/spotlight/ten-threats-to-global-health-in-2019

World Health Organization. (2020). Behavioural considerations for acceptance and uptake of COVID-19 vaccines. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/337335/9789240016927-eng.pdf?sequence=1&isAllowed=y