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ORIGINAL CONTRIBUTION

Agricultural workers in meatpacking plants presenting to an emergency department with suspected COVID-19 infection are disproportionately Black and Hispanic

Hans R. House MD, MACM[1] | J. Priyanka Vakkalanka PhD, ScM[1,2] | Nathan G. Behrens[3] | Jessica De Haan PA-C[3] | Christopher R. Halbur[3] | Elaine M. Harrington[3] | Pooja H. Patel[3] | Lulua Rawwas[3] | Carlos A. Camargo Jr MD, DrPH[4] | Jeffrey A. Kline MD[5]

[1]Department of Emergency Medicine, University of Iowa, Iowa City, Iowa, USA

[2]Department of Epidemiology, University of Iowa College of Public Health, Iowa City, Iowa, USA

[3]Carver College of Medicine, University of Iowa, Iowa City, Iowa, USA

[4]Department of Emergency Medicine, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts, USA

[5]Department of Emergency Medicine, Wayne State University School of Medicine , Detroit , Michigan , USA

Correspondence
Jeffrey A. Kline, Department of Emergency Medicine, University of Indiana School of Medicine, Indianapolis, IN 46202, USA.
Email: jefkline@iu.edu

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Abstract

Objective: Facilities that process and package meat for consumer sale and consumption (meatpacking plants) were early sites of coronavirus disease 2019 (COVID-19) outbreaks. The aim of this study was to characterize the association between meatpacking plant exposure and clinical outcomes among emergency department (ED) patients with COVID-19 symptoms.

Methods: This was a retrospective cohort study of patients presenting to a single ED, from March 1 to May 31, 2020, who had: 1) symptoms consistent with COVID-19 and 2) a COVID-19 test performed. The primary outcome was COVID-19 positivity, and secondary outcomes included hospital admission from the ED, ventilator use, intensive care unit (ICU) admission, hospital length of stay (LOS; <48 or ≥48 h), and mortality.

Results: Patients from meatpacking plants were more likely to be Black or Hispanic than the ED patients without this occupational exposure. Patients with a meatpacking plant exposure were more likely to test positive for COVID-19 (adjusted relative risk [aRR] = 2.37, 95% confidence interval [CI] = 1.59 to 3.53) but had similar rates of hospital admission (aRR = 0.94, 95% CI = 0.82 to 1.07) and hospital LOS (aRR = 0.76, 95% CI = 0.45 to 1.23). There was no significant difference in ventilator use among patients with meatpacking and nonmeatpacking plant exposure (8.2% vs. 11.1%, p = 0.531), ICU admissions (4.1% vs. 12.0%, p = 0.094), and mortality (2.0% vs. 4.1%, p = 0.473).

Conclusions: Workers in meatpacking plants in Iowa had a higher rate of testing positive for COVID-19 but were not more likely to be hospitalized for their illness. These patients were disproportionately Black and Hispanic.

INTRODUCTION

Early in the coronavirus disease (COVID-19) pandemic, facilities that process and package meat for consumer sale and consumption (meatpacking plants) were identified as potential sources of outbreaks.[1] These meatpacking plants are located throughout the country and employed 527,000 people in 2017. On July 10, 2020, the Centers for Disease Control and Prevention (CDC) published an update to their previous report on outbreaks in meatpacking plants in their *Morbidity and Mortality Weekly Report* (*MMWR*).[1] The CDC identified 17,358 cases during April and May 2020 across 239 facilities spanning 23 states, finding 3.1% to 24.5% of workers tested positive for COVID-19. The *MMWR* article cited multiple factors contributing to these outbreaks, including close workspace contact, congregate break areas, shared transportation, and bonus pay that incentivizes attendance. The CDC report also suggests that "Hispanic and Asian workers might be disproportionately affected by COVID-19." The workers in meatpacking plants in general are more often Black or Hispanic and more likely to be immigrants compared to the average United States population.[2]

The Iowa Department of Public Health declined to participate in the CDC's report. Consequently, the state's meatpacking plant outbreaks were not included in the analysis.[3] Yet, by examining public data and popular press reports, it has been shown that Iowa plants suffered the most number of cases in the country though mid-May 2020.[4] The largest occurred at the Waterloo Tyson Foods plant in Blackhawk County, where 1,031 workers tested positive.[5] Some of the patients from these plant outbreaks were treated at Iowa's main referral hospital in Iowa City, a large, tertiary care center with an annual emergency department (ED) census of over 60,000 visits. The aim of this study was to characterize the association between meatpacking plant exposure and outcomes of COVID-19 positivity, hospital admission, ventilator use, intensive care unit (ICU) admission, hospitalization stays ≥ 48 h, and mortality among patients treated in this facility's ED for symptoms consistent with COVID-19 infection.

METHODS

Study design, sample, and setting

This study was nested within the Multicenter REgistry of potential COVID-19 in emERgency care (Project RECOVER), which was designed to acquire data from patients who visited a U.S. ED and were tested in the next 14 days for SARS-CoV-2. The methods of the RECOVER registry have been published previously.[6] RECOVER is a network of 45 emergency medicine clinician investigators representing 155 hospitals. Trained abstractors obtained data from the electronic medical record using 204 predefined questions. The Iowa site was selected for the current analysis because it permitted identification of those with exposure to meatpacking plants. Place of employment or exposure to a meatpacking plant was not one of the original defined clinical questions in RECOVER, but was specifically included for charts reviewed by abstractors at this one site. We performed a retrospective cohort study of patients less than 65 years of age presenting to the single ED from March 1 to May 31, 2020, who had: 1) symptoms consistent with COVID-19 (including cough, fever, shortness of breath, chest pain, or gastrointestinal symptoms [nausea, vomiting, abdominal pain]) and 2) a COVID-19 test performed. Patients were excluded if they received an "asymptomatic COVID-19 screen" test as part of routine hospital admission protocol. This study was approved by the local institutional review board and is reported according to STROBE guidelines.

Measurement of exposures and covariates

All demographic and clinical (comorbidities and disposition) data were ascertained by trained reviewers and recorded into standardized abstraction instruments. The primary exposure was exposure to a meatpacking plant, defined as any documentation of work in a meatpacking plant by the patient or a family member, as recorded by the treating provider at the time of the encounter. Demographic data obtained included age, sex, race, ethnicity, and insurance status. The RECOVER registry uses the terms "Hispanic or Latino vs. non-Hispanic or Latino" to categorize ethnicity. As done in CDC studies, we will henceforth use the term "Hispanic."[1,7] Clinical characteristics included past medical history pertinent to our study outcomes (e.g., comorbidities such as diabetes, smoking, substance use disorder, systemic hypertension, heart disease, obesity, hyperlipidemias, heart failure, atrial fibrillation, cancer, chronic obstructive pulmonary disease, prior venous thromboembolism, asthma, other lung disease, and organ transplant) and situational variables (arrival by EMS, transferred).

Outcomes

The primary outcome in this study was COVID-19 positivity, identified from the medical record for any test results done within 14 days of the ED encounter (usually at the time of the ED visit but occasionally performed at an outpatient testing center prior to the ED visit). Secondary outcomes included hospital admission from the ED, ventilator use (defined here as an indication of use of high-flow oxygen, noninvasive positive pressure ventilation, and intubation), ICU admission, hospital length of stay (LOS) among hospitalized patients, and mortality. Hospital LOS was characterized as < 48 h or ≥ 48 h as a marker for acuity, whereby < 48 h was considered primarily for observation and lower acuity.

Data analysis

All demographic and clinical characteristics were evaluated descriptively by meatpacking plant exposure status. Due to the relatively rare events of ventilator use, ICU admissions, and mortality, we report these outcomes descriptively (percentages and chi-square analysis comparisons by meatpacking plant exposure). For the remaining outcomes of COVID-19 positivity, hospital admission, and hospital LOS, we evaluated the relationship between meatpacking plant exposure with each outcome through log-binomial regression, which yielded relative risk (RR) estimates and 95% confidence intervals (CIs). Multivariable models were built through purposeful selection of covariates based on clinical experience and extant literature.[8] We then applied the following parameters to address potential confounding: initial selection of candidate variables at α= 0.25, multivariable model significance at α = 0.25, and confounding level at 15.[9] All analyses were completed using SAS version 9.4.

RESULTS

Characteristics of sample

From March 1 to May 31, 2020, a total of 582 patients with suspected COVID-19 were seen in this facility's ED. Overall, the median age of patients was 42 (interquartile range [IQR] = 29–55), 50% were male, and 68% were White (Table 1). Most frequently occurring comorbidities included systemic hypertension (36%), obesity (29%), and hyperlipidemias (21%).

Among all patients, 8.4% had a meatpacking plant as the potential source of their exposure. Nearly 60% of patients with a meatpacking exposure were of Hispanic ethnicity, compared to approximately 10% of patients without this exposure. Those with a meatpacking plant exposure also consistently had a lower proportion of comorbidities reported and younger age (Table 1).

Outcomes

Overall, 56% (*n* = 325) of patients were admitted from the ED. While 100 patients (17%) tested positive for COVID-19 overall, 74% of meatpacking plant–exposed patients and 12% of those without a meatpacking plant exposure tested positive for COVID-19 (Table 2). In the multivariable model, those with a meatpacking plant exposure were 2.37 (95% CI = 1.59 to 3.53) times as likely to test positive for COVID-19.

In the unadjusted model, those with a meatpacking plant exposure were 0.60 (95% CI = 0.41 to 0.89) times as likely to be admitted compared to those without this exposure (Table 2). In the multivariable model, there was no significant difference in hospital admission proportions between those who had a meatpacking plant exposure compared to those who did not (adjusted RR [aRR] = 0.94, 95% CI = 0.82 to 1.07). Approximately 8% of those exposed to meatpacking plants required a ventilator, compared to 11% of those without this exposure (p = 0.531). Additionally, although 4% of those with an exposure to these plants were admitted to ICUs compared to 12% of those without the exposure, this was not significantly different by exposure status (p = 0.094).

Among admitted patients (*n* = 325), 64% had a hospital LOS ≥ 48 h. Approximately 65% of patients without a meatpacking plant exposure and 47% with a meatpacking plant exposure had a hospital LOS ≥ 48 h, although this did not differ significantly by exposure status (aRR = 0.76, 95% CI = 0.45 to 1.22). In-hospital mortality did not vary significantly by meatpacking plant exposure (2.0% vs. 4.1%, p = 0.473).

DISCUSSION

In this study, we identified and characterized ED patients associated with meatpacking plants during the early months of the COVID-19 pandemic. As seen previously in the CDC study, the patients in our sample were much more likely to be people of color.[1] People of color have been disproportionately affected by the COVID-19 pandemic in the United States, with Hispanic and Black patients becoming infected at rates two to four times the general population.[7,10] As seen in this study, patients from meatpacking plants had a much higher rate of testing positive for COVID-19 than compared to other patients who presented to the same ED with COVID-19–like symptoms. This population represented an early wave of the disease in the state of Iowa and may have served to amplify the epidemic in the counties with meatpacking plants.[4]

After potential confounders were adjusted for, these patients were not more likely to be admitted or to be hospitalized for a long period of time. It is unclear why the meatpacking population in our sample had a similar rate of hospitalization despite testing positive much more frequently. As seen in Table 1, they were on average younger and were significantly less likely to smoke than the general ED population, so would be at lower overall risk for poor outcomes from COVID-19 disease. However it is also possible that this difference in hospitalization reflects an inherent health care disparity. Meatpacking plant workers are more likely to be non-English speakers, and this may lead to a misunderstanding or dismissal of their health concerns.[2] Studies have found that non-English speakers are triaged at a lower severity level and are more likely to return to the ED for a repeat visit of the same complaint.[11,12] If hospitalized, patients with limited English proficiency were shown to have a shorter LOS, possibly due to an incomplete understanding of their condition.[13]

Meatpacking plants employ over 10,000 people in Iowa, and the state has the highest concentration of animal slaughterers and meat packers in the country.[14] According to the Iowa Department of Agriculture and Land Stewardship, 253 licensed meat and poultry plants employ workers throughout the state.[15] It is not known how many meatpacking plant workers have become ill or died from COVID-19 in Iowa, because the state did not participate in the national CDC study on the subjects and has not independently published data on the subject.[3] The CDC reported that, through May 31, 2020, there were at least 17,358 cases and 91 deaths from COVID-19 in meat and poultry processing workers. This was at a time when the total number of cases in the United

TABLE 1 Characteristics of population presenting to the ED by meatpacking plant exposure

Characteristic	Overall (*N* = 582) Total	%	Meatpacking + (*n* = 49) *n*	%	Meatpacking − (*n* = 533) *n*	%	p-value[a]
Demographics							
Sex							
Female	294	50.5	21	42.9	273	51.2	0.263
Male	288	49.5	28	57.1	260	48.8	
Age (years)							
≤17	59	10.1	5	10.2	54	10.1	0.965
18–24	48	8.3	4	8.2	44	8.3	
25–44	207	35.6	19	38.8	188	35.3	
45–64	268	46.0	21	42.9	247	46.3	
Race[b]							
White	393	67.5	4	8.2	389	73.0	<0.001
Black or African American	81	13.9	17	34.7	64	12.0	
Other/Unknown	108	18.6	28	57.1	80	15.0	
Ethnicity[b]							
Hispanic/Latino	91	15.6	28	57.1	63	11.8	<0.001
Not Hispanic or Latino	483	83.0	20	40.8	463	86.9	
Unknown	8	1.4	1	2.0	7	1.3	
Insurance							
Private/commercial	304	52.2	37	75.5	267	50.1	<0.001
Medicaid	159	27.3	3	6.1	156	29.3	
Medicare	45	7.7	1	2.0	44	8.3	
Medicaid/Medicare	27	4.6	0	0.0	27	5.1	
Worker's compensation	1	0.2	0	0.0	1	0.2	
No health Insurance/self-pay	18	3.1	3	6.1	15	2.8	
Unknown	28	4.8	5	10.2	23	4.3	
Clinical characteristics							
Past medical history							
Diabetes	117	20.1	8	16.3	109	20.5	0.491
Smoking	105	18.0	1	2.0	104	19.5	<0.001
Substance use disorder	88	15.1	1	2.0	87	16.3	0.008
Systemic hypertension	210	36.1	15	30.6	195	36.6	0.405
Heart disease	42	7.2	0	0.0	42	7.9	0.040
Obesity	171	29.4	11	22.5	160	30.0	0.266
Hyperlipidemias	124	21.3	4	8.2	120	22.5	0.019
Heart failure	46	7.9	0	0.0	46	8.6	0.025
Atrial fibrillation	29	5.0	0	0.0	29	5.4	0.160
Cancer	70	12.0	1	2.0	69	13.0	0.025
Chronic obstructive pulmonary disease	55	9.5	0	0.0	55	10.3	0.010
Prior venous thromboembolism[c]	28	4.8	0	0.0	28	5.3	0.100
Asthma	105	18.0	3	6.1	102	19.1	0.023
Organ transplant	15	2.6	0	0.0	15	2.8	0.623
Arrived by EMS	131	22.5	7	14.3	124	23.3	0.150
Transferred	85	14.6	1	2.0	84	15.8	0.009

[a]p-values determined by chi-square test or Fisher's exact test when expected count was < 5.

[b]Due to preset categories in the Registry, non-White Hispanic/Latino persons were categorized as "other /unknown" for race, as distinguished from ethnicity (Hispanic yes/no). Of the 108 "other/unknown" persons for race, 91 of these are Hispanic/Latino (categorized separately under ethnicity). Of the remaining 17 patients whose race or ethnicity is other/unknown, 13 were Asian and four truly had unknown race and/or ethnicity status.

[c]Includes those with documented deep vein thrombosis and/or pulmonary embolism.

TABLE 2 Association between meatpacking plant exposure status and outcomes

Outcomes	Meatpacking + (n = 49)		Meatpacking − (n = 533)		uRR	95% CI	aRR	95% CI
	n	%	N	%				
Primary outcome: COVID positive[a]								
Yes	36	73.5	64	12.0	6.12	(4.60–8.13)	2.37	(1.59–3.53)
No	13	26.5	469	88.0	Ref			
Secondary outcome: admitted[b]								
Yes	17	34.7	307	57.6	0.60	(0.41–0.89)	0.94	(0.82–1.07)
No	32	65.3	226	42.4	Ref			
Secondary outcome: hospital LOS[c]								
>48 h	8	47.1	199	64.8	0.73	(0.44–1.21)	0.76	(0.45–1.26)
≤48 h	9	52.9	108	35.2	Ref			

Abbreviations: aRR, adjusted relative risk; COVID positive = laboratory confirmed; LOS, length of stay; uRR, unadjusted relative risk.

[a]Final model adjusted for meatpacking plant exposure, age, ethnicity, cancer, diabetes, smoking, and substance use disorder.

[b]Final model adjusted for meatpacking plant exposure, age, ethnicity, COVID positivity, cancer, diabetes, substance use disorder, and EMS transport.

[c]Among admitted patients only. Final model adjusted for meatpacking plant exposure, age, and EMS transport.

States was 1.7 million. Therefore, since there are approximately 525,000 meatpacking workers in the United States, these workers were becoming infected at a rate 10 times the general population.[1] As seen in Bureau of Labor Statistics data, these patients live throughout the country, with the highest numbers in the Midwest and South.[14]

The disparities that have been exacerbated by COVID-19 are deeply entrenched in the structures that reinforce power hierarchies. Workers in food production facilities have risked their health and that of their families to maintain the food supply to the nation; however, despite being deemed essential workers, they have been denied protection against a life-threatening infection.[16] Often, workers in agriculture are systemically marginalized groups with limited economic resources, social power, and access to health care. Nationally, meatpacking workers are twice as likely to be Black or Hispanic than the average U.S. worker. They are also twice as likely to be foreign born.[2] Even when they are able to obtain care, language and health literacy barriers may exist. Furthermore, workers may live with extended family, making it difficult to quarantine. In Waterloo, Iowa, for example, workers at the Tyson Plant are drawn from a variety of immigrant communities, including Southeast Asia, the Pacific Islands, and Central Africa.[16] Language barriers and cramped living conditions may contribute to their health care disparities. Workplace policies likely contributed directly to the worker's risk of exposure. They are actively discouraged from taking sick leave via a point system that penalizes absences and encouraged to work despite illness.[17] The Tyson company, for example, provided a $500 incentive pay for not missing a shift in 3 months.[18] A lawsuit by Tyson workers alleges other negligence in managing the outbreak at their plants, including a lack of personal protective equipment, ignoring symptoms of illness, managers avoiding the cutting room floor, and managers even taking bets on how many workers would contract the virus.[18]

Government actions at the time did not help protect workers and further contributed to their continued exposure. Official guidance from OSHA was limited and nonbinding, and the Trump administration invoked an executive order to ensure that these plants maintained operations.[19] Evidence from investigative journalism shows that the administration's executive order was developed directly from language provided by the meatpacking industry lobbyists.[20] As a final blow to protecting workers, the corporations were protected from legal liability by Iowa state legislation.[16]

Agricultural workers face a higher risk of encountering zoonotic infections, and modern food production practices are clearly linked to new disease emergence and amplification.[21]

Although downstream effects of plant closures pose a hardship to consumers and food preparers (schools, catering, and restaurants), these workers require adequate protection from infection. Moving forward, it is vital that worksite prevention and control practices be implemented alongside screening and access to testing and treatment. Analysis of infection rates in Nebraska meatpacking plants have demonstrated that multimodal infection prevention measures were effective at limiting worker illness.[22] Access to COVID-19 education materials that consider language, culture, and literacy should be provided as well as personal protective equipment for workers and their families. Looking ahead to possible future new zoonotic infections, monitoring the health of agricultural workers will contribute to disease surveillance.[21] In the case of COVID-19, infections among meatpacking plant workers were the first major outbreaks of the disease in rural counties.[4] It is possible that the next pandemic could begin or be quickly amplified in a meatpacking plant in Iowa just as it was in a live market in China.

LIMITATIONS

This study was conducted as a part of collecting data for the RECOVER registry, so the demographic and clinical questions were predefined before this study was initiated. Ideally, a question would have been included in the registry about working in a meatpacking plant so that this study could have drawn from a much larger sample than the one location. The patient interview and its inclusion in the chart was the sole source of determining exposure to a meatpacking plant. This was not a standardized question in the earliest period of the pandemic, prior to the reporting of meatpacking plant outbreaks in the press. Following the first meatpacking plant outbreak, asking about work in such a facility became more routine among providers in this ED. This may have led to potential misclassification of some patients by exposure status; however, because outcomes were not expected to be misclassified differentially by exposure status, we would expect potential underestimation of the observed associations. Additionally, as this ED is not located in county with a meatpacking plant, we may have had a selection bias for patients who opted to travel to our facility. Since they were able to travel, they would be more likely to be well enough to do so and not require hospital admission. Similarly, the majority of those who were exposed to the meatpacking plant in this study were employees of these plants. Employment status was not known in the nonmeatpacking plant group. If there was a higher proportion of patients in the exposed group who were healthy and working compared to the second group, this could have also resulted in a healthy worker effect. We attempted to mitigate this by accounting for other known comorbidities at baseline. This study was conducted in the early part of the pandemic in Iowa, when most large-scale sets of cases occurred in meatpacking plants. It is possible that the risk profile for COVID-19 disease is different since the disease has become more widespread.

CONCLUSIONS

Workers in meatpacking plants in Iowa had a higher rate of testing positive for COVID-19 but were not more likely to be hospitalized for their illness. These patients were disproportionately Black and Hispanic.

CONFLICT OF INTEREST

The authors have no potential conflicts to disclose.

AUTHOR CONTRIBUTIONS

Jeffrey A. Kline convened the multicenter group to develop the patient registry. Hans R. House conceived the study and organized the data collection. Nathan G. Behrens, Jessica De Haan, Christopher R. Halbur, Elaine M. Harrington, Pooja H. Patel, and Lulua Rawwas conducted the chart review and assembled the data collection. J. Priyanka Vakkalanka provided the statistical analysis. Hans R. House, J. Priyanka Vakkalanka, Elaine M. Harrington, and Christopher R. Halbur drafted the manuscript. Carlos A. Camargo Jr provided substantial revisions to the manuscript. Hans R. House and J. Priyanka Vakkalanka revised the manuscript in response to reviewer comments, with assistance from Carlos A. Camargo Jr, Jessica De Haan, and Christopher R. Halbur. Jeffrey A. Kline provided the funding and final oversight of the project.

ORCID

Hans R. House https://orcid.org/0000-0003-0398-1126
Nathan G. Behrens https://orcid.org/0000-0002-5503-7623
Carlos A. Camargo Jr https://orcid.org/0000-0002-5071-7654
Jeffrey A. Kline https://orcid.org/0000-0001-7190-3109

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