

Incidence and Predictors of COVID-19 Infection in Prison Healthcare Workers

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Specific Author Contributions

J. Caruth led the study design, assisted with data collection, provided oversight of the writing of the manuscript and prepared drafts of the manuscript for review with co-author input.

K. Black supervised data management, provided oversight of the manuscript writing.

A. Legard assisted with data management.

A. De Resende assisted with data management.

K. Getz completed the statistical analysis and provided input during the course of manuscript writing.

M. Borowski provided input during the course of the manuscript writing.

L. DeBilio assisted with data collection and provided input during the course of the manuscript writing.

A. Brewer conceived the study, supported data acquisition, provided input during the course of manuscript writing and liaised with the state department of corrections for their approval of the study for publication.

H. Kipen provided input during the course of the manuscript writing.

I. Udasin provided input during the course of the manuscript writing.

J. Graber led the study design and provided oversight of all aspects of the analysis and the writing of the manuscript.

All authors reviewed the final manuscript draft.

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ACCEPTED

Abstract

Objectives: To assess the predictors of SARS-CoV-2 infection among correctional healthcare workers (HCWs).

Methods: We conducted a retrospective chart review to describe the demographic and workplace characteristics of New Jersey correctional HCWs between 03/15/2020 and 08/31/2020, using univariate and multivariable analysis.

Results: Among 822 HCWs, patient-facing staff had the highest incidence of infection (7.2%). Associated risk factors include being Black and working in a maximum-security prison. There were few statistically significant findings due to small total numbers (n=47), that tested positive.

Conclusions: Correctional HCWs' challenging work environment creates unique risk factors for infection with the SARS-CoV-2 virus. Administrative measures taken by the department of corrections may have a significant role in curbing the spread of infection. The findings can help focus preventive measures for reducing the spread of COVID-19 in this unique population.

KEY WORDS: COVID-19; SARS-CoV-2; correctional; prison; healthcare workers.

BULLETED LEARNING OUTCOMES:

- To assess the individual characteristics (job-title, age, sex, and race) of correctional healthcare workers that may have increased risk of infection with the SARS-CoV-2 in the early stages of the pandemic, from March 2020 to August 2020.
- To describe correctional facility characteristics (facility size, security level and location and resident characteristics) that may have increased healthcare workers' rate of infection with the SAR-CoV-2 virus in the early stages of the pandemic, from March 2020 to August 2020.
- To describe administrative measures that correctional facilities can take during an initial outbreak of an emerging pathogen to help decrease the transmission of infection among its residents and health care workers.

INTRODUCTION

During the first few months of the pandemic, many US health systems were unprepared to curb the spread of the then emerging pathogen, including being unable to provide appropriate personal protective equipment (PPE) for all their staff in a timely manner. In the prison system, attempts at curbing the spread of the SARS-CoV-2 virus may have been amplified due to additional challenges with ventilation and limited ability of staff and incarcerated persons to practice social distancing.

In the United States in 2020, there were about 2.1 million adults housed in approximately 5,000 correctional facilities, which include federal and state prisons, local jails, and detention

centers.(1) In the prison system, infectious disease outbreaks like tuberculosis and influenza can have potentially devastating consequences for health care workers (HCWs), incarcerated persons, staff members, and their surrounding communities.(2) Incarcerated persons are more likely to have chronic illnesses such as hypertension and heart disease as compared to the general population (4). They may therefore be more at risk of having severe disease necessitating more interactions with HCWs. In addition, congregate housing models, such as those found in correctional facility settings, increase the risk of transmission of viral diseases.

In a recent study, the case rate of COVID-19 in US federal and state prisoners was reported to be 5.5 times higher than that of the US population. Crude COVID-19 death rates were also higher in the prison population.(3) Between March 31, 2020 and September 06, 2022, the total number of cases of COVID-19 reported from state Departments of Corrections, the Federal Bureau of Prisons and Immigration Customs and Enforcement was 864,564. Of these, 23,030 cases were reported from New Jersey and included 8,351 corrections staff with 307 (3.7%) deaths among staff and 14,679 residents cases with 3,128 (21%) deaths among residents.(4),(5)

The burden of COVID-19 incidence and mortality in the United States has been disproportionally born by racial and ethnic minorities, who face significant health disparities. These disparities may be driven by pervasive structural inequities. People of color are disproportionately represented among the incarcerated. New Jersey (NJ) has the greatest racial disparity among incarcerated populations in the US. Although only 14% percent of NJ residents are Black, Black people make up 54% of the NJ prison population. Compared to White New Jersey residents, the incarceration rate is approximately 9 times higher among Blacks, 2.8 times

higher among Hispanics and 3.3 times higher among American Indian/Alaska Natives.(8). Incarcerated persons have higher rates of chronic diseases including asthma, obesity and diabetes, infectious diseases and mental illness compared with the general population.(6-9). Certain chronic underlying diseases such as diabetes, hypertension, heart disease and chronic pulmonary disease, increase the risk of more severe disease.(10) Persons with more severe disease may have higher viral loads and be more infectious for longer periods of time,(11) Therefore correctional HCWs in New Jersey may be at increased risk of exposure to the SARS-CoV-2 virus because infected incarcerated persons may have more severe disease, require more care and may be infectious for longer periods of time.

Many US correctional facilities have HCWs employed on site. These HCWs may be at increased risk of SARS-CoV-2 infection due to their work environment that can include difficulties in practicing social distancing, overcrowding, and poor ventilation.(12) These HCWs face additional challenges due to the unpredictable work setting and security issues. In the prison setting, security issues are often of higher concern than infection control.(13-15) There is a dearth of research available regarding SARS-CoV-2 infection rates and COVID-19 among correctional HCWs. A study published in May 2020 aggregated data on COVID-19 cases in correctional and detention facilities in 37 state and territorial health departments. More than half of the included facilities reported cases among staff members. Among the facilities, COVID-19 was diagnosed in 2,778 facility staff members resulting in 79 hospitalizations (3%) and 15 deaths (1%). COVID-19 was diagnosed in 4,893 incarcerated or detained persons with 88 deaths (2%).(1) A limitation of the study was that it did not report the total number of healthcare staff and detained/incarcerated persons at risk and did not specifically address the risk to correctional

HCWs.(16)

Our research characterizes SARS-CoV-2 infection rates in the healthcare staff working in New Jersey correctional facilities between March 15, and August 31, 2020 at the onset of the pandemic. The goal is to provide insight into preventative measures that can be implemented in future waves of this disease and other emerging pathogens, and to develop a platform for additional research in this unique population.

METHODS

Data and Data Sources

Employees of University Correctional Health Care (UCHC) provide health care to incarcerated persons, residents, and parolees of the New Jersey Department of Corrections (NJDOC). In New Jersey, incarcerated persons have access to healthcare services and are required to pay for part of their medical cost. They are however not denied medical care if they cannot afford to pay.(17) We analyzed existing health and employment records from all correctional HCWs employed by UCHC between March 15, and August 31, 2020. HCWs included physicians, nurses, dentists, medical technicians, mental health clinicians and medical support staff such as medical secretaries and schedulers. For further details on how jobs titles were categorized, see Supplemental Digital Content, Table A, <http://links.lww.com/JOM/B318>.

Before May 2020, employees were tested for SARS-CoV-2 for cause (either when exposed or symptomatic). Starting on May 07, 2020, a mandatory weekly program was instituted for employees to be tested once they were working on site. Employees could also report test results

from outside clinics. We only included PCR-based SARS-CoV-2 test results obtained from three sources: 1) Routine weekly UCHC universal testing (from May 7, 2020); 2) Internal ad hoc testing through employee health and, 3) Outside clinics results provided by employees, which must have included a laboratory report (March 15 to August 31, 2020).

Weekly universal testing and internal ad hoc testing for the SARS-CoV-2 ribonucleic acid was done by analyzing saliva samples using reverse transcription polymerase chain reaction (RT-PCR) at the Rutgers Clinical Genomics Laboratory, reference laboratory – RUCDR (Rutgers University Cell & DNA Repository) Infinite Biologics, in Piscataway, New Jersey. The test was developed by RUCDR in partnership with Spectrum Solutions, (the manufacturer of the saliva collection system), and Accurate Diagnostic Labs and was granted FDA emergency use authorization.⁽¹⁸⁾ The results were reported via Accurate Diagnostics Labs. For internal ad hoc testing, results were reported directly to employee health.

Test results were reviewed and excluded if they were from either agency employees (contract employees not assigned to a specific correctional facility) or non-correctional HCWs.

Once an employee tested positive, they were censored out of the study and not put back in if they returned to work and tested negative.

Individual demographic and employment data were provided by the UCHC system. The demographic data included workers' age in years, sex (male or female), race/ethnicity, job title, work location and length of employment in years (calculated as the difference between hire date

and, if no longer working, termination date. If no termination date is provided, the last date tested for SARS-CoV-2 is used to calculate the length of employment). Most UCHC employees were assigned either to the administrative offices or to one of 14 correctional facilities. The correctional facilities are under the purview of the NJDOC, including 13 facilities, and the Juvenile Justice Commission (JJC), which consists of three facilities located on two campuses. For our study, we categorized the JJC facilities as one facility.

NJDOC provided facility-level data from the Automated Medical Observation System (AMOS) Census mid-monthly NJDOC facility incarcerated person census reports made between March 15 and August 31, 2020, and from direct communication with the UCHC. Facilities were categorized by resident population age and sex, prison size (operationalized as small (<1000 incarcerated persons), medium (1000 to 1500 incarcerated persons) and large (> 1500 incarcerated persons)), the highest level of security in the facility (minimum, medium, maximum), and geographic location (if the facility was located in a high COVID risk zip code as of August 13, 2020). (Supplemental Digital Content, Table B, <http://links.lww.com/JOM/B319>).(19)

Though there was some level of depopulation of each facility, the majority of facilities assigned to a given size based on its occupancy, remained in the same size category throughout the study period. For one facility however, the occupancy level was that of a large population size category facility (>1500 residents) during the first and third months. However, for the remaining four months, its average occupancy level placed the facility in the medium population size category facility (>1000 to 1500 residents). For the purpose of our study, we therefore categorized this

facility as a medium population size prison throughout the study period.

The study was approved by the Rutgers University Institutional Review Board.

Data Analysis

All categorical measures were first summarized using frequencies and percentages. A series of logistic regression models were then fit to assess the relationships between facility and/or HCWs characteristics with the primary outcome of ever testing positive for SARS-CoV-2 during study follow-up. The covariates used in the models were chosen based on clinical and public health knowledge as well as prior literature. One logistic regression model was fit using individual-level characteristics, which included sex, race, job title and employment duration. A separate logistic model was fit using facility-level characteristics, which included average employment duration, prison security level, prison population size, prison population type, and whether the prison was in a high-risk COVID-19 exposure zip code. For the facility-level model only, anyone who worked at multiple prisons was excluded from the analysis due to having multiple different facility-level characteristics; additionally, since none of the people who worked at multiple locations ever tested positive for SARS-CoV-2, separate outcome categories for them could not be created. As a model diagnostic, we assessed the predictive performance of the model in classifying whether an employee was ever positive. The model was fitted on a randomly selected 70% study sample and predictions made in the remaining 30%. For the individual-level model the misclassification rate was 6.2% and the area under the receiver operating characteristics (ROC) curve (AUC) was 0.66, and for the facility-level model the misclassification rate was 7.2% and the AUC was 0.59.

An overall survival Kaplan-Meier (KM) curve was plotted, with time to first SARS-CoV-2 positive test as the outcome. KM curves from the adjusted model that were stratified by individual- and facility-level characteristics were created. A Cox proportional hazards model using both the individual-level and facility-level characteristics was also fit, and the proportional hazards assumption was verified.

RESULTS

During our study period, 3,889 test results from 881 correctional facility employees were available for review. Eighty results from agency employees and three non-correctional HCWs were excluded leaving 3,806 eligible test results from 822 employees. The majority, 3,698 (97%), were from the mandated weekly workplace-based universal testing. Eighty-two test results were from internal ad hoc testing; 26 were self-reported. Within the study period, employees had between 1 and 16 SAR-CoV-2 PCR tests with a mean of 5 tests per person. We received an additional 30 reports of SARS-CoV-2 infection without PCR tests that were excluded from this study.

Most of the HCWs were female (77.5 %) with a mean age of 49 years old. More than half (58%) were nurses or medical technicians and 38% were Black (Table 1). Among the 822 employees, 47 (5.7%) had at least one confirmed infection with SARS-CoV-2. There appeared to be lower rates of SARS-CoV-2 infection among the oldest employees and higher rates among Black and other non-White employees, but confidence intervals were wide. Medical care personnel, which included nurses and medical technicians, accounted for 72% (34) of cases, with an infection rate

of 7.2% (95% CI: 4.9, 9.5), (Table 1). Consistent with this observation, in the individual-level logistic regression analysis over five times higher odds of infection was seen among medical care workers (odds ratio (OR) 5.6, 95% CI: 1.6, 35.0) and other workers (OR 5.2, 95% CI: 1.3, 35.1) compared to mental health clinicians (Table 2). Highest infection rates were seen among employees with less than 12 years of employment in the correctional health care field.

Within facility type, infection rates were almost half those in medium compared with maximum-security facilities (3.5% [95% CI: 1.5, 5.5] vs 7.3% [95% CI: 4.8, 9.9]), respectively) and facilities designated as low-risk vs high-risk zip codes (4.4 [95% CI: 2.3, 6.1] vs 7.4% [4.8, 10.1]), respectively (Table 1). In the regression analysis, positive associations were seen between SARS-CoV-2 positivity and COVID-19 risk in the surrounding area, as well as higher odds of infection for employees working in medium sized facilities compared to large sized prisons (Table 3).

HCWs working in medium-security facilities appeared to have a lower risk of infection when compared with those working in maximum-security facilities (OR =0.26 (95% CI 0.02, 0.94) but the confidence interval was unstable (Table 3). Similar results were seen in the survival analysis (Table 4). In stratified lifetables, some interesting time-related observations were seen including that in the higher risk categories, including medical care workers and those working in medium sized facilities, there appeared to be a higher risk of testing positive for SARS-CoV-2 within the first 5 weeks of the study (Figure 1).

DISCUSSION

We observed that the overall positivity rate of confirmed SARS-CoV-2 infection for HCWs in the New Jersey state correctional facilities during our study period was six percent. Of note, we observed higher infection rates among some of the potentially most vulnerable workers, including those between ages 50 and 60, persons of color, and employees working in maximum-security facilities.

The overall infection rate was comparable to the findings of Gibson et al. In their study of 84 correctional facilities between March 2020 and June 09, 2020, the self-reported COVID-19 positivity rate for healthcare staff was 8%. The authors also noted that for incarcerated persons, the self-reported positivity rate was 17% and for correctional officers 11%.(20)

In our study, the rate of infection in direct-patient-facing staff, i.e., doctors, nurses, dental staff and medical technicians, was 7%. Similarly, Barrett et al, in a screening study of hospital workers, found that employees in similar direct-patient care roles had higher rates of infection than those without such roles. In addition, phlebotomists were found to have the highest rates of infection.(21) Other workers were found to have to have a high odds of infection; however, the precision of the OR in the group may not be accurate given the wide confidence interval of 2.2 to 31.2.

During the pandemic, treatment options evolved as understanding of the COVID-19 disease pathology increased and increasingly impacted the course of infection by reducing infectiousness. Treatment recommendations were published and frequently updated by the

National Institute of Health (NIH).(22-24) We did not collect data on the specific treatment received by HCWs or incarcerated persons during our study.

In an effort to control infections, the NJDOC took several measures during the study period, which may have influenced our results. One measure taken at the beginning of the pandemic was the suspension of required copayments for medical visits so that financial concerns would not be an issue for incarcerated persons seeking health care. Incarcerated persons who sought health care may have increased the risk of exposure to direct patient-care workers such as nurses and medical technicians. However, the NJDOC also limited interactions between staff and incarcerated persons including the temporarily cancellation of non-emergency medical trips and procedures. Only emergency dental issues were being addressed during this time, which may have contributed to the low rate of SARS-CoV-2 infection found in the dental staff of less than three percent.

In our study, infection with the SARS-CoV-2 virus was twice as high for non-White employees compared to White employees. These findings were similar to those of Barrett et al., who found that the COVID-19 infection rates were 2-fold higher in Black and Latinx hospital workers compared with White hospital workers.(21) Differences in infection by race have also been noted among prisoners. In a 2020 nine-week study that included 84 correctional facilities, among facilities reporting on race/ethnicity, Black incarcerated persons were diagnosed with COVID-19 over three times more often than white incarcerated persons, and Hispanic incarcerated persons almost six time more often compared with non-Hispanic individuals. The authors noted that, “Racial disparities in COVID-19 infection rates have been documented in the community and

clearly appearing in corrections as well.”(20)

Incarcerated persons housed in maximum-security facilities were at higher risk of SARS-CoV-2 infection compared with those housed in minimum and medium-security facilities likely as a result of the housing arrangements, infrastructure and staffing differences.

In the NJDOC, incarcerated persons in minimal-security facilities are typically housed in dormitory type housing. In medium-security facilities, they are housed in combination of dormitory type accommodations and cells. These cells may have single or double bunk beds. Housing in maximum-security prisons consists of cells with single or double bunk beds. According to the most recent Bureau of Statistics census report from 2019, incarcerated persons in maximum-security facilities have lower imprisoned person-to-security staff ratios (4:1). This ratio increases as the security level falls with medium-security facilities having a 5:1 ratio and minimum security facilities having a 6:1 ratio.(25)

The averaged reported ratio for New Jersey in state and federal prisons combined in 2019 was 3:1. A breakdown of this ratio based on prison security levels is not available.

Incarcerated persons assigned to maximum-security custody are highly supervised and are assigned to activities that are confined to the correctional facility.(26) The increased staffing and close supervision in maximum-security prisons may lead to greater transmission for all prison employees.

A decrease in the occupancy rates at NJDOC facilities may also have affected infection rates among healthcare workers. In an effort to curtail the spread of COVID-19 in the prison system, Governor Phil Murphy signed Executive Order No. 124 on April 10, 2020. This Order provided a process for the release of eligible medically vulnerable incarcerated persons. Persons who committed violent or serious crimes were not eligible for this early release program, including many of the persons imprisoned in maximum-security facilities. Those incarcerated persons who were released went to a temporary emergency home confinement.⁽¹⁶⁾ Based on the data provided by the NJDOC AMOS census reports and the capacity of each NJDOC facility,⁽²⁷⁾ the occupancy level of the maximum-security prisons in March 2020 ranged between 57 to 92%. By August 2020, it ranged from 47 to 90%. In contrast, the medium-security facilities occupancy fell from 54 to 98% in March 2020, to 40 to 80% in August 2020. The greater depopulation of the medium-security prisons may have contributed to the lower risk to the HCWs of SARS-CoV-2 infection.

HCWs in medium sized prisons had a higher risk of SARS-CoV-2 infection. This increased risk may be the result of the degree of prison depopulation which varied by prison size. At the beginning of the pandemic, the small sized prisons were between 57% and 94% occupancy capacity. By mid-August 2020, they were between 40% and 80% capacity. Large sized prisons were at 83% to 97% capacity in March 2020, falling to 79% to 86% capacity by mid-August 2020. For the medium sized prisons at the start were between 77 % and 92% capacity, then by mid-August 59% to 90% capacity.⁽²⁷⁾ Though the percentage occupancy fell for all prison sizes, the decrease was less for medium size prisons and at least one medium sized prison was still at 90% occupancy as of mid-August 2020.

There are several potential limitations to be considered for our study. The study period was from March 15 to August 31, 2020. Since the pandemic is ongoing, the information gathered from the study may not be generalizable to the entire pandemic experience in the correctional HCWs. Prior to May 07, 2020, HCWs were primarily getting tested for COVID-19 if they had a concern for an exposure or symptoms suggestive of COVID-19. Mandatory weekly universal testing of all employees who were working on-site began on May 07, 2020. Therefore, the number of weekly tests performed prior to May 07, 2020, would be fewer than the number performed thereafter. Another possible limitation is that we did not include self-reported COVID-19 positive cases that were not substantiated by a positive PCR result, so we are likely underestimating infection rates. We also could not include per diem HCWs who were not UCHC employees. In addition, complete demographic and employment records of all tested employees were not available. We do not know the degree to which correctional staff or visiting relatives introduced the SARS-CoV-2 virus into the prison. We therefore acknowledge that this could influence the number of cases within each facility. We also were not able to assess any impact of SARS-CoV-2 infection in incarcerated persons on our findings nor assess implications for the incarcerated population of staff infections. The relatively small number of SARS-CoV-2 infections during the study period led to some wide confidence intervals and an inability to fully assess some associations. For example, while we tried to assess whether location within a high-transmission zip code contributed to infection rates, we were only able to assess this using two levels of risk (high vs low).

There were some challenges in obtaining data to characterize correctional healthcare facilities. For example, prison size was categorized based on the census within the prison; however, there

is no specific standard by which to classify the state prisons into small, medium or large sizes.

Public Health Implications

Health care workers in correctional facilities have unique risk factors for infection with the SARS-CoV-2 virus apart from individual characteristics (e.g. race, age), such as their professional role and the type of facility. Protective administrative measures taken at the facility level may have helped limit the spread of the virus. A successful example may have been limiting dental services to emergencies-only during the pandemic, which may have contributed to reduced infection rates among the dental staff. In addition, the depopulation of prisons may have benefited those working in medium-security facilities compared to workers in maximum-security facilities likely because a higher degree of depopulation was achieved in those facilities. This depopulation may have overall decreased the population density of incarcerated persons thereby reducing the transmission of the SARS-CoV-2 virus within correctional facilities, especially among the medically vulnerable incarcerated persons. As an emerging pathogen, SARS-CoV-2 brought to light areas of concern that facilities can address to effectively minimize the spread of future emerging pathogens.

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Figure 1: Survival plots of time to seroconversion by key characteristics



MH1: Psychiatrists in manager/director role; MH2: psychiatrists (non-managerial/non director role), mental health clinicians; Medical care 1: includes nurses (registered nurses, advanced practical nurses, licensed practical nurses), medical technicians, phlebotomists & physician assistants. Medical care 2: includes physicians, optometrists, physical therapists & recreational therapists. Dental: dentists, dental assistants & dental hygienists. Other: administrative staff

Table 1. Healthcare worker and facility characteristics overall and by SARS-COV-2 seropositivity (n=822)

Characteristic	Overall (n=822)			SARS-COV-2 Positive (n=47)		
	n	(%)	(95% CI)	n	%	(95% CI)
Healthcare worker characteristics						
All				47	5.7	(4.3, 7.5)
Sex						
Male	185	22.5	(19.7, 25.4)	8	4.3	(1.3, 7.2)
Female	637	77.5	(74.6, 80.4)	39	6.1	(1.4, 7.2)
Age (years)						
20-39	195	23.7	(20.8, 26.6)	10	5.1	(2.0, 8.3)
40-49	237	28.8	(25.7, 31.9)	15	6.3	(3.2, 9.4)
50-59	237	28.8	(25.7, 31.9)	17	7.1	(3.8, 10.4)
60-69	128	15.6	(13.1, 18.1)	5	3.9	(0.6, 7.3)
>70	25	3.0	(1.9, 4.2)	0	0	(0.0, 13.7)
Race						
White	402	48.9	(45.5, 52.3)	15	3.7	(1.9, 5.6)
Black	308	37.5	(34.2, 40.8)	23	7.5	(4.5, 10.4)
All other ^a	112	13.6	(11.3, 16.2)	9	8.0	(3.0, 13.7)
Job Title						
Dental care	40	4.9	(3.4, 6.3)	1	2.5	(0, 7.3)
Medical care - nurses, other	473	57.6	(54.2, 61.0)	34	7.2	(4.9, 9.5)
Medical care - physicians	40	4.9	(3.4, 6.3)	3	0	(0, 8.1)
Mental health -clinician supervisor/managers	22	2.7	(1.6, 3.8)	0	0	(0, 15.4)
Mental health clinicians	156	18.9	(16.2, 21.5)	2	0	(0, 2.3)
Other ^b	91	11.1	(8.9, 13.2)	7	7.7	(2.2, 31.2)
Employment duration (years)						

0 to <5	290	35. 4	(32.1, 38.6)	17	5.9	(3.2, 8.6)
5 to <12	378	46. 1	(42.7, 49.5)	26	6.9	(4.3, 9.4)
≥12	152	18. 5	(15.9, 21.2)	4	2.6	(0.1, 5.1)
Healthcare workers by facility characteristics^c (n=780)						
Prison Security - highest level						
Maximum (n=6)	465	59. 6	(56.2, 63.2)	34	7.3	(4.8, 9.9)
Medium (n=8)	315	39. 8	(36.9, 43.8)	11	3.5	(1.5, 5.5)
Prison population size ^d						
Large (>1500; n=4)	364	46. 7	(43.2, 50.2)	19	5.2	(2.9, 7.5)
Medium (1000-1500; n=3)	126	16. 2	(13.6, 18.7)	11	8.7	(3.8, 13.7)
Small (<1000; n=7)	290	37. 1	(33.8, 40.6)	15	5.2	(2.4, 7.5)
Prison population type						
Adult men only (n=10)	549	70. 4	(67.2, 73.6)	35	6.4	(4.4, 8.8)
Adult women only (n=1)	64	8.2	(6.3, 10.1)	2	3.1	(0, 7.4)
Youth (n=3)	167	21. 4	(18.5, 24.3)	8	4.8	(0, 2.8)
Zip code COVID risk status						
High risk (n=6)	367	47. 1	(43.6, 50.6)	27	7.4	(4.8, 10.1)
Low risk (n=8)	413	52. 9	(49.5, 56.5)	18	4.4	(2.3, 6.1)

95% Wald confidence intervals (zero cells used Fisher Exact (Clopper-Pearson estimation) calculated using <https://www.openepi.com/Proportion/Proportion.htm>

a. “Other” race-ethnicity includes: American Indian/Alaska Native (1.8%), Asian (59.8%), Hispanic (31.3%), self-identified/selected as other (7.1%)

b. “Other” job title: See supplementary Table A.

c. 42 workers were removed from the facility analysis. These included 12 Healthcare workers that worked in multiple facilities and 30 that worked in the administration building.

d. There is no standard classification of the size of a prison based on the incarcerated person or resident capacity. The size of the prison here is described by the correctional facility is based on the incarcerated person census at the time. See supplementary Table B for facility characteristics.

Table 2. The association between individual-level characteristics and SARS-COV-2 positivity estimated using multivariable logistic regression (n=822)

Characteristic	Odds ratio	(95% CI)	P-value
Health care worker characteristics			
Sex			
Female	1		
Male	0.82	(0.3, 1.7)	0.63
Race			
White	1		
Black	1.62	(0.8, 3.3)	0.17
Other	1.93	(0.8, 4.5)	0.14
Job Title			
Mental health	1		
Medical care	5.58	(1.6, 35.0)	0.02
Other	5.22	(1.3, 35.1)	0.04
Employment duration (years)			
	0.99	(0.9, 1.1)	0.68

Table 3: Association between facility-level characteristics and SARS-COV-2 positivity
estimated using multivariable logistic regression (n=792)

	Odds Ratio	(95% CI)	P-value
Health care worker characteristics			
Average years of employment at each facility	0.95	(0.9,1)	0.15
Prison Security - highest level			
Maximum	1		
Medium	0.26	(0.02,0.94)	0.11
Prison population size			
Large (>1000)	1		
Medium (1000-1500)	2.11	(0.9,4.7)	0.07
Small (<1000)	1.44	(0.7,3.1)	0.35
Prison population type			
Adult Male	1		
Youth	0.46	(0,1.8)	0.37
Zip code COVID risk status			
High risk	1		
Low risk	1.33	(0.4,19.1)	0.74

Table 4. – Risk of SARS-CoV-2 infection estimated using Cox proportional hazard models
(n=780)

	HR	(95% CI)	P-value
Sex			
Female	1		
Male	0.93	(0.4,2)	0.85
Race			
White	1		
Other	1.59	(0.7,3.7)	0.29
Black	1.08	(0.5,2.2)	0.83
Job Title			
Mental health	1		
Medical care	5.95	(1.4,25.4)	0.02
Other	6.04	(1.2,31.7)	0.03
Dental	1.94	(0.2,21.6)	0.59
Prison Security - highest level			
Maximum	1		
Medium	0.42	(0.2,0.9)	0.02
Prison population size			
Large (>1500)	1		
Medium (1000-1500)	1.97	(0.9,4.3)	0.08
Small(<1000)	1.05	(0.5,2.1)	0.89
Prison population type			
Adult Male	1		
Youth	0.80	(0.4,1.8)	0.59

Table A. Categorization of Job Titles

Medical care	Mental Health
Administrator of Nursing Services	Associate Director of Psychiatry
Advance Practice Nurse	Clinician Supervisor
Advance Practice Nurse – Per diem (PD)	Director of Psychiatry
Dental Assistant	Forensic Mental Health Clinician
Dental Hygienist	Manager Clinical Services
Dentist	Manager Clinical Services - Testing
Dentist - PD	MHC(Mental Health Clinician) 2
Department Nurse Manager	MHC(Mental Health Clinician) 3
Director of Dentistry	Psychiatrist
Infection Control Nurse	Psychiatrist - PD
(Licensed Practical Nurse)LPN	Psychiatrist Regional Managers
LPN - PD	Psychology Intern
Managing Physician Specialist	Other
Medication Aide	Chief Operating Officer
Nurse Trainer	Clinician Administrator
Occupational Therapist	Data Control Clerk I
Optometrist	Director of Operations & Accreditation
Optometrist - PD	Director of Pharmacy
Phlebotomist	Director of Training
Physical Therapist	Health Records Clerk
Physical Therapist - PD	Medical Records Director
Physician Assistant	Principal Management Assistant
Physician I	Program Administrator
Physician II	Program Development Specialist II
Physician Specialist	Program Manager-Infection Control
Recreational Therapist	Program Support Specialist
Regional Nurse Manager	Programmer Analyst I
School Nurse Coordinator	Project Manager
Senior (Sr). LPN	QI Specialist Ombudsperson
Staff Nurse	Quality Improvement Director
Staff Nurse - PD	Regional Scheduler
Supervising Dentist	Secretary 1
UHC Technician I	Secretary 3
UHC Technician II	Staff Assistant
	Statewide Medical Director
	Utilization Management
	Coordinator

Table B. Facility characteristics

Facility No.	SECURITY LEVELS	Size	Population	Zip code COVID risk
1	Medium	Small	Adult male	Low
2	Medium	Small	Adult male	Low
3	Medium	Large	Adult male	Low
4	Medium	Medium	Adult male	Low
5	Maximum	Small	Adult female	High
6	Maximum	Medium	Adult male	High
7	Medium	Small	Young male	High
8	Maximum	Large	Young male	Low
9	Medium	Small	Youth mixed	Low
10	Maximum	Large	Adult male	High
11	Maximum	Small	Adult male	High
12	Maximum	Large	Adult male	High
13	Medium	Medium	Adult male	Low
14	Medium	Small	Adult Male	Low