



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

COVID-19 vaccination in the Federal Bureau of Prisons, December 2020–April 2021



Liesl M. Hagan^{a,b,*}, Charles Dusseau^{b,c}, Michael Crockett^{b,c}, Tami Rodriguez^{b,c}, Michael J. Long^{b,c}

^a Centers for Disease Control and Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, Division of Viral Hepatitis, 1600 Clifton Road NE, Atlanta, GA 30333, United States

^b Federal Bureau of Prisons, Health Services Division, 320 First Street NW, Washington, DC 20534, United States

^c Commissioned Corps of the United States Public Health Service, 1101 Wootton Pkwy, Plaza level, Rockville, MD 20852, United States

ARTICLE INFO

Article history:

Received 13 July 2021

Received in revised form 10 August 2021

Accepted 11 August 2021

Available online 14 August 2021

Keywords:

COVID-19 vaccine

SARS-CoV-2

Federal Bureau of Prisons

ABSTRACT

Objectives: To describe COVID-19 vaccine distribution operations in United States Federal Bureau of Prisons (BOP) institutions and offices from December 16, 2020–April 14, 2021, report vaccination coverage among staff and incarcerated people, and identify factors associated with vaccination acceptance among incarcerated people.

Methods: The BOP COVID-19 vaccination plan and implementation timeline are described. Descriptive statistics and vaccination coverage were calculated for the BOP incarcerated population using data from the BOP electronic medical record. Coverage among staff was calculated using data from the Centers for Disease Control and Prevention Vaccination Administration Management System. Vaccination coverage in the BOP versus the overall United States adult population was compared by state/territory. Univariate and multivariable logistic regression models were developed to identify demographic, health-related, and institution-level factors associated with vaccination acceptance among incarcerated people, using hierarchical linear modeling to account for institution-level clustering.

Results: By April 14, 2021, BOP had offered COVID-19 vaccination to 37,870 (100%) staff and 88,173/126,413 (69.8%) incarcerated people, with acceptance rates of 50.2% and 64.2%, respectively. At the time of analysis, vaccination coverage in BOP was comparable to coverage in the overall adult population in the states and territories where BOP institutions and offices are located. Among incarcerated people, factors associated with lower vaccination acceptance included younger age, female sex, non-Hispanic Black and Asian race/ethnicity, and having few underlying medical conditions; factors associated with higher acceptance included having a prior SARS-CoV-2 infection, being born outside the United States, and being assigned to a Federal Detention Center.

Conclusions: Early COVID-19 vaccination efforts in BOP have achieved levels of coverage similar to the general population. To build on this initial success, BOP can consider strategies including re-offering vaccination to people who initially refused and tailoring communication strategies to groups with lower acceptance rates.

Published by Elsevier Ltd.

1. Introduction

During the COVID-19 pandemic, the United States Federal Bureau of Prisons (BOP) has experienced high transmission rates of SARS-CoV-2 (the virus that causes COVID-19) due to institutions' congregate living environments and challenges implementing

physical and social distancing, as well as high mortality rates from COVID-19 [1–3]. To control transmission, BOP has applied the Centers for Disease Control and Prevention (CDC) COVID-19 guidance for correctional settings, including recommended environmental cleaning, diagnostic and screening testing for SARS-CoV-2, medical isolation for incarcerated people testing positive and quarantine for those who have been exposed and tested negative, quarantine for new entrants and those preparing for release or transfer, restricting staff from work if symptomatic or testing positive, suspending in-person visitation and group programming, and limiting movement between BOP institutions [4,5]. In addition, from March 2020–April 2021, under authority of the Coronavirus Aid, Relief,

* Corresponding author at: 1600 Clifton Road NE, Mailstop 12-3, Atlanta, GA 30333, United States.

E-mail addresses: vqf8@cdc.gov (L.M. Hagan), cdusseau@bop.gov (C. Dusseau), mcrockett@bop.gov (M. Crockett), t1rodriguez@bop.gov (T. Rodriguez), mzlong@bop.gov (M.J. Long).

and Economic Security (CARES) Act, BOP placed 16.8% of its pre-pandemic incarcerated population in home confinement or authorized their early release, prioritizing people with conditions associated with increased risk for severe COVID-19 illness as defined by CDC [6].

In December 2020, BOP received an independent allocation of COVID-19 vaccine from the federal government, with sufficient doses to offer vaccination to all directly-employed BOP staff and all people incarcerated in BOP-managed institutions. This article reports vaccination coverage among staff and incarcerated people as of April 14, 2021; presents demographic, health-related, and institution-level factors associated with vaccination acceptance among incarcerated people; and discusses potential strategies to promote vaccination among people from subgroups less likely to accept vaccination.

2. Methods

2.1. Population and institutions

The Federal Bureau of Prisons includes 122 BOP-managed institutions, eight administrative offices, and two staff training centers across 36 states, Washington, DC, and Puerto Rico. Analyses described below include the 37,870 directly-employed staff working in BOP-managed institutions, administrative offices, and training centers and the 126,413 incarcerated people (83.0% of the total BOP census) assigned to BOP-managed institutions as of April 14, 2021 [7,8]. Staff employed by external entities and people incarcerated in privately-managed BOP institutions or Residential Reentry Centers were not covered by the BOP COVID-19 vaccine allocation and were not included in analyses. The number of externally employed staff working in BOP institutions was not available.

2.2. COVID-19 vaccine allocation, distribution, and prioritization

Beginning in September 2020, BOP worked directly with CDC and the Federal Government COVID-19 Vaccine and Therapeutics Operation, formerly known as Operation Warp Speed, to develop a COVID-19 vaccine prioritization and distribution plan. Through this process, it was determined that vaccination would first be

offered to staff due to their ongoing potential to introduce the virus into a facility from the community, or to transmit it from the facility to the community through daily movements; vaccination would then be offered to incarcerated people.

The BOP vaccine allocation has included all vaccine products with an Emergency Use Authorization (EUA) in the United States (i.e., Pfizer-BioNTech, Moderna, and Janssen/Johnson & Johnson COVID-19 vaccines). Vaccine distribution across BOP facilities is overseen by a Vaccine Allocation Group that includes BOP pharmacists, physicians, infection control nurses, and health services administrators. Collectively, this group determines which vaccine product each institution receives, the number of doses, and the schedule of delivery based on institutions' population characteristics, storage capabilities, and staff capacity to administer vaccine at any given time.

The Janssen vaccine, the only available single-dose option, has been distributed primarily to BOP's Federal Detention Centers, where people are held temporarily before and during trial. Because the length of time an individual will spend in a Federal Detention Center is difficult to predict, using a single-dose vaccine increases the likelihood that people held in these settings will be fully vaccinated before they are released to the community or transferred to another institution after trial.

BOP received its first vaccine shipment on December 16, 2020. The first institutions to receive vaccine doses were BOP's seven Federal Medical Centers, which house people who have high-acuity medical needs, many of which overlap with conditions associated with higher risk of severe COVID-19 illness [6]. Within each institution, vaccination was initially offered to all staff and subsequently to incarcerated people based on an assigned Vaccine Priority Level (Table 1). Vaccine Priority Level for incarcerated people was determined by their work assignment within the institution (with work assignments considered essential, such as food service, assigned a high Vaccine Priority Level), presence of underlying medical conditions associated with higher risk of severe COVID-19 illness, and assignment to a nursing care center within a Federal Medical Center [6]. Vaccine Priority Level was re-evaluated daily to reflect changes in eligibility. Date of vaccination eligibility for any given individual was dependent on the availability of vaccine within their assigned institution and, for incarcerated individuals, their Vaccine Priority Level. (See Supplemental Material for addi-

Table 1
Vaccine Prioritization Level assigned to staff and incarcerated people in the Federal Bureau of Prisons (BOP), December 2020–April 14, 2021.

COVID-19 Vaccine Priority Level	Description	Incarcerated People Assigned to each Vaccine Priority Level ¹ n (%)
Staff People incarcerated	COVID-19 vaccination was offered first to all directly-employed BOP staff	NA
Priority Level 1	Assigned to a high priority work placement within the institution; nursing care center residents ²	11,166 (8.8%)
Priority Level 2	Meet CDC criteria for people who have a higher risk of severe illness from COVID-19 ³ ; people age 65 and older regardless of other risk criteria	77,311 (61.1%)
Priority Level 3	Meet CDC criteria for people who may have a higher risk of severe illness from COVID-19 ⁴ ; people age 50–64 regardless of other risk criteria	26,255 (20.8%)
Priority Level 4	General population	10,963 (8.7%)
Vaccine potentially not indicated ⁵	People currently in medical isolation for SARS-CoV-2 infection; people who received a non-COVID-19 vaccination ≤ 14 days prior; people who received monoclonal antibody treatment ≤ 90 days prior; people with an allergy to a COVID-19 vaccine	718 (0.6%)

¹Includes BOP-managed institutions only; excludes Residential Reentry Centers and prisons managed by private entities.

²High priority work assignments include food service, cleaning for health services units, and others designated critical infrastructure roles. Nursing care center residents are those with underlying medical conditions requiring high-level care in one of the seven BOP Federal Medical Centers.

³CDC criteria for people with higher risk of severe illness from COVID-19 have changed over time. At the time when BOP defined its Vaccine Priority Groups, these included body mass index ≥30, cancer, chronic kidney disease, chronic obstructive pulmonary disease, history of solid organ or stem cell transplant, pregnancy, sickle cell disease, history of smoking, serious cardiac conditions, and type II diabetes.

⁴CDC criteria for people with higher risk of severe illness from COVID-19 have changed over time. At the time BOP defined its Vaccine Priority Groups, these included moderate/severe asthma, body mass index >25 but <30, cardiovascular disease, cystic fibrosis, dementia, hypertension, immunocompromised state, liver disease, pulmonary fibrosis, thalassemia, and type I diabetes.

⁵Eligibility for COVID-19 vaccination was re-evaluated daily using an algorithm applied to updated data.

tional details related to BOP's vaccine distribution model and timeline.)

2.3. COVID-19 vaccine education, administration, and reporting

COVID-19 vaccination was voluntary for both staff and incarcerated people. Vaccines were administered by existing BOP clinical staff, who were trained to educate staff and incarcerated people regarding vaccine products' safety, efficacy, and side effects, and to address individuals' questions about their vaccination decisions. Each institution and office determined how vaccination was offered based on characteristics including the security level of the institution, layout of housing units, and number of staff available to provide education about the vaccines. Institutions implemented a combination of vaccination clinics targeting entire housing units, vaccination offers to small groups, and one-to-one encounters.

Staff vaccinations were documented in the BOP module of the CDC Vaccine Administration Management System (VAMS); however, staff vaccinations occurring outside of BOP (e.g., through staff members' healthcare providers, a health department, or community clinic) are not reflected in the BOP VAMS module and were not available to include in analyses. Vaccination of incarcerated people was documented in the BOP electronic medical record (BEMR) and reported to CDC daily. When incarcerated people were offered vaccination, they were required to sign either a consent form or a declination form, which were also stored in BEMR. Staff and incarcerated people who originally declined vaccination could request it later at any time. Incarcerated people could access a copy of their vaccination records through a request to BOP Health Services staff at their assigned institution.

At the time of this analysis, vaccination efforts within BOP were still ongoing; vaccination had been offered to all staff and will continue until it has been offered to all incarcerated people as well. After that point, institutions will continue to offer vaccination to new entrants, people who previously declined the vaccine, and newly-hired staff.

2.4. Statistical methods

2.4.1. COVID-19 vaccine distribution and administration

The total number of COVID-19 vaccine doses distributed to BOP institutions from December 16, 2020–April 14, 2021, the median and range in the number of doses administered per day, and the percentage of total distributed doses administered during this time period were calculated.

2.4.2. COVID-19 vaccination among incarcerated people

Using data from BEMR, descriptive statistics were calculated characterizing BOP's overall incarcerated population, as well as the subset who were offered and accepted COVID-19 vaccination, in terms of demographic, health-related, and institution-level factors. Vaccination acceptance was defined as receiving the first dose of a two-dose COVID-19 vaccine series or receiving one dose of a single-dose COVID-19 vaccine. The number and percentage of people incarcerated in BOP institutions who were offered COVID-19 vaccination were calculated, as well as the number and percentage who a) received at least one dose of a COVID-19 vaccine and b) were fully vaccinated. Fully vaccinated was defined as having received both doses of a two-dose COVID-19 vaccine series or one dose of a single-dose COVID-19 vaccine, consistent CDC definitions from the COVID Data Tracker website [9]. The number and percentage of incarcerated people who were offered vaccination a second time after an initial signed declination, and the number and percentage who accepted the second offer, were also calculated.

Cross-sectional analysis using univariate logistic regression models was performed to identify individual-level factors (age, sex, race/ethnicity, country of birth, prior SARS-CoV-2 infection, number of medical conditions associated with severe COVID-19 illness) and institution-level factors (BOP-defined geographic region and institution type) associated with vaccination acceptance among incarcerated people to whom it was offered. Hierarchical Linear Modeling (HLM) was used to account for potential clustering at the institution level. People with ≥ 7 medical conditions associated with severe COVID-19 illness were aggregated into a single category due to small cell sizes. Unadjusted odds ratios (OR) and 95% confidence intervals (CI) are presented.

Using the results of the univariate models, a multivariable logistic regression model was built to identify factors that are independently associated with vaccination acceptance among incarcerated people to whom it was offered, again using HLM to account for potential clustering at the institution level. All variables that were statistically significant in univariate models (OR estimates with 95% CI that do not include 1.0) were included in the multivariable model. Adjusted odds ratios (aOR) and 95% CI are presented. People who had completed a COVID-19 vaccine series prior to incarceration in the BOP system were not included in vaccination acceptance models but were retained in descriptive analyses of vaccination coverage in the BOP population.

2.4.3. COVID-19 vaccination among staff

The number and percentage of BOP staff who a) received at least one dose of a COVID-19 vaccine and b) were fully vaccinated through BOP's workplace vaccination campaign were calculated, using the number of staff with vaccination documentation in the BOP VAMS module as the numerator and the total number of BOP staff (including those not represented in the BOP VAMS module) as the denominator.

2.4.4. Comparison of COVID-19 vaccination coverage in BOP vs. the overall population, by state/territory

For each of the 38 states and territories where BOP institutions and/or offices are located, vaccination coverage among BOP staff and incarcerated people (combined) was calculated and compared to vaccination coverage in the overall adult population as of April 14, 2021. Data on vaccination coverage for overall state/territorial adult populations were downloaded from the CDC COVID Data Tracker website, which includes all entities that submit COVID-19 vaccination data to CDC, including BOP; BOP-affiliated records could not be separated from the overall adult state/territorial populations [9].

All analyses were performed using SAS Enterprise Guide 8.3 (Cary, North Carolina, US).

2.5. Human subjects determination

This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy. CDC determined that its involvement in this analytic project did not constitute engagement in research involving human subjects; CDC IRB review was not required. This project employs secondary analysis of pre-existing data collected by BOP for routine clinical and operational purposes; BOP IRB review was not required.

3. Results

3.1. COVID-19 vaccine distribution to BOP institutions and overall vaccination coverage

From December 16, 2020–April 14, 2021, 137,790 COVID-19 vaccine doses were delivered to BOP institutions, and 132,161

(95.9%) were administered (Supplemental Figure 1), with a median of 328 doses administered per day (range: 0–6,938). Approximately half (75,695/164,283, 46.1%) of BOP staff and incarcerated people combined received at least one vaccine dose during this time period, and 33.9% (55,667/164,283) were fully vaccinated.

3.2. Demographic characteristics and COVID-19 vaccination coverage among incarcerated people

Demographic and institution-level characteristics of people incarcerated in BOP institutions are presented in Table 2. The BOP incarcerated population was predominantly male (93.6%),

Table 2
Demographic and health-related characteristics and institution assignments of people incarcerated in the Federal Bureau of Prisons (BOP), April 14, 2021¹.

	N	%
Total	126,413	100.0%
Age		
<40	63,121	49.9%
40–49	37,117	29.4%
50–59	17,957	14.2%
60–74	7,671	6.1%
75+	547	0.4%
Sex		
Female	8,148	6.4%
Male	118,265	93.6%
Race/Ethnicity		
American Indian/Alaska Native	3,133	2.5%
Asian	1,805	1.4%
Black	49,733	39.3%
Hispanic	32,022	25.3%
White	39,720	31.4%
Country of Birth		
Non US-born	15,750	12.5%
US-born	109,634	86.7%
Unknown	1,029	0.8%
Prior SARS-CoV-2 Infection		
No	79,988	63.3%
Yes	46,425	36.7%
Number of Medical Conditions Associated with Severe COVID-19 Illness²		
0	13,152	10.4%
1	29,535	23.4%
2	38,347	30.3%
3	27,669	21.9%
4	12,125	9.6%
5	4,079	3.2%
6	1,072	0.9%
≥7	434	0.4%
BOP Region		
Mid-Atlantic Region	24,036	19.0%
North Central Region	18,409	14.6%
Northeast Region	18,651	14.8%
South Central Region	24,560	19.4%
Southeast Region	24,178	19.1%
Western Region	16,579	13.1%
Type of Institution		
Prison Camp ³	2,823	2.2%
Low Security Prison	33,055	26.2%
Medium Security Prison	54,805	43.4%
High Security Prison	20,014	15.8%
Federal Detention Center ⁴	8,969	7.1%
Federal Medical Center ⁵	6,747	5.3%

¹Includes BOP-managed institutions only; excludes Residential Reentry Centers and institutions managed by private entities.

²At the time these data were collected, medical conditions associated with severe COVID-19 illness, as defined by CDC, included moderate/severe asthma, body mass index >25 but <30, body mass index ≥30, cancer, serious cardiac conditions, cardiovascular disease, chronic kidney disease, chronic obstructive pulmonary disease, cystic fibrosis, dementia, hypertension, immunocompromised state, liver disease, pregnancy, pulmonary fibrosis, sickle cell disease, history of smoking, history of solid organ or stem cell transplant, thalassemia, and type I and type II diabetes.

³Prison Camps are minimum security institutions with limited or no perimeter fencing. These institutions are work- and program-oriented; incarcerated people assigned to camps may have work placements off-site or within adjacent BOP institutions.

⁴Federal Detention Centers (FDC) hold incarcerated people during trial. Length of stay in an FDC may range from several days to a year or more, depending on the length of the trial.

⁵Federal Medical Centers house incarcerated people with high-acuity medical needs and include nursing care centers.

Table 3

COVID-19 vaccination acceptance among people incarcerated in the Federal Bureau of Prisons, by demographic, health-related, and institution-level characteristics, April 14, 2021^{1,2}.

	Accepted COVID-19 vaccination			Unadjusted Models	Adjusted Model
	n	Percent of total (%)	Percent of sub-group (%)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Total	56,568				
Age					
<40	22,417	39.6	54.9	1	
40–49	18,161	32.1	67.6	1.74 (1.68, 1.80)	1.61 (1.55, 1.66)
50–59	10,459	18.5	76.3	2.63 (2.51, 2.75)	2.18 (2.07, 2.29)
60–74	5,122	9.1	81.5	3.50 (3.26, 3.75)	2.61 (2.43, 2.81)
75+	409	39.6	84.9	4.20 (3.25, 5.42)	2.71 (2.09, 3.52)
Sex					
Female	3,877	7.4	62.3	0.72 (0.64, 0.81)	0.60 (0.53, 0.67)
Male	52,691	92.6	64.3	1	1
Race/Ethnicity					
American Indian/Alaska Native	1,511	2.7	73.7	1.02 (0.92, 1.13)	1.09 (0.98, 1.22)
Asian	833	1.5	68.8	0.80 (0.71, 0.91)	0.79 (0.68, 0.91)
Black	18,321	32.4	51.3	0.38 (0.37, 0.40)	0.43 (0.41, 0.44)
Hispanic	14,251	25.2	72.5	0.96 (0.92, 1.0)	1.05 (1.0, 1.10)
White	21,652	38.3	73.3	1	1
Country of Birth					
Non US-born	6,734	11.9	75.2	1.92 (1.82, 2.03)	1.42 (1.34, 1.51)
US-born	49,496	87.5	62.9	1	1
Unknown	338	0.6	70.6	1.35 (1.09, 1.67)	1.42 (1.14, 1.77)
Prior SARS-CoV-2 infection					
No	33,825	59.8	62.8	1	1
Yes	22,743	40.2	66.3	1.15 (1.12, 1.19)	1.08 (1.05, 1.12)
Number of Medical Conditions Associated with Severe COVID-19 Illness					
0	2,916	5.2	50.1	1	1
1	10,093	17.8	57.2	1.29 (1.21, 1.37)	1.21 (1.13, 1.29)
2	17,584	31.1	62.8	1.62 (1.53, 1.72)	1.47 (1.39, 1.57)
3	14,767	26.1	67.3	1.99 (1.87, 2.12)	1.77 (1.66, 1.89)
4	7,338	13.0	73.2	2.63 (2.45, 2.83)	2.10 (1.95, 2.26)
5	2,741	4.9	78.3	3.44 (3.11, 3.80)	2.54 (2.29, 2.82)
6	784	1.4	84.0	4.81 (3.98, 5.80)	2.99 (2.46, 3.63)
≥7	345	0.6	86.3	5.26 (3.91, 7.08)	2.89 (2.13, 3.91)
BOP Region					
Mid-Atlantic Region	12,681	22.4	65.7	1	–
North Central Region	8,232	14.6	62.5	0.95 (0.57, 1.58)	–
Northeast Region	8,425	14.9	61.1	0.98 (0.59, 1.63)	–
South Central Region	11,388	20.1	66.6	1.14 (0.69, 1.87)	–
Southeast Region	9,397	16.6	61.3	1.10 (0.66, 1.81)	–
Western Region	6,445	11.4	68.0	1.38 (0.84, 2.29)	–
Type of Institution					
Prison Camp	990	1.8	47.9	0.64 (0.34, 1.22)	0.60 (0.32, 1.12)
Low Security Prison	15,628	27.6	68.9	1.18 (0.82, 1.71)	0.97 (0.68, 1.38)
Medium Security Prison	25,282	44.7	63.6	1	1
High Security Prison	8,703	15.4	66.5	1.29 (0.83, 2.0)	1.37 (0.90, 2.09)
Federal Detention Center	2,007	3.5	64.7	2.09 (1.37, 3.19)	1.96 (1.30, 2.94)
Federal Medical Center	3,958	7.0	74.9	1.55 (0.82, 2.93)	1.15 (0.63, 2.13)

¹Vaccination acceptance was defined as receiving the first dose of a two-dose COVID-19 vaccine series or receiving one dose of a single-dose COVID-19 vaccine. Excludes 103 people who were fully vaccinated prior to incarceration.

²Includes BOP-managed institutions only; excludes Residential Reentry Centers and institutions managed by private entities.

with a median age of 40 years (range: 18–95). A plurality (39.3%) of incarcerated people were non-Hispanic Black, 31.4% were non-Hispanic White, and 25.3% were Hispanic. 36.7% had a prior SARS-CoV-2 infection, and 89.6% had at least one medical condition associated with higher risk of severe COVID-19 illness (median: 2 conditions; range: 0–11). The incarcerated population was relatively evenly distributed among the six BOP-defined geographic regions of the United States.

As of April 14, 2021, BOP had offered COVID-19 vaccination to 88,173/126,413 (69.8%) incarcerated people, and 56,568 (64.2%) accepted. Of the total incarcerated population, 56,671 (44.8%) had received at least one vaccine dose, and 37,787 (29.9%) had been fully vaccinated. Of the 37,787 incarcerated people who had

been fully vaccinated, 103 had been vaccinated prior to incarceration in BOP. Of 2,514 people who signed a vaccine declination form and were offered vaccination a second time, 1,415 (56.3%) accepted the second offer.

3.3. Predictors of COVID-19 vaccination acceptance among incarcerated people

Table 3 presents the results of unadjusted and adjusted logistic regression analyses, identifying factors associated with COVID-19 vaccination acceptance among incarcerated people to whom it was offered. In adjusted analysis, the multivariable model included age, sex, race/ethnicity, country of birth, prior SARS-CoV-2 infec-

Table 4

Percentage of adults who received COVID-19 vaccination by state/territory, overall state/territory population versus staff and incarcerated people in the Federal Bureau of Prisons (BOP), April 14, 2021¹.

State	Percent of Adult Population Receiving at Least One Dose (%)		Percent of Adult Population Fully Vaccinated (%)	
	State Overall ²	BOP ³	State Overall ²	BOP ³
Alabama	36.7	45.6	22.1	35.2
Arizona	45.2	47.3	28.6	30.7
Arkansas	40.8	48.2	24.8	37.6
California	50.0	41.0	27.8	32.0
Colorado	49.1	41.1	29.6	31.3
Connecticut	56.0	45.4	35.9	44.3
District of Columbia ⁵	45.0	40.7	24.9	40.7
Florida	43.6	39.6	27.0	26.3
Georgia	39.6	40.0	21.4	24.2
Hawaii	46.7	59.7	32.5	59.3
Illinois	49.9	49.0	28.9	32.4
Indiana	40.6	51.3	27.3	35.2
Kansas	49.4	51.9	30.4	29.4
Kentucky	46.6	48.4	31.1	43.8
Louisiana	38.9	41.7	27.6	30.6
Maryland	50.3	42.6	31.7	41.7
Massachusetts	54.9	65.9	32.5	57.3
Michigan	45.1	36.8	29.6	12.6
Minnesota	51.2	49.1	34.2	32.1
Mississippi	36.5	38.8	25.3	25.5
Missouri	40.9	50.7	27.0	48.3
New Hampshire	65.2	44.4	31.3	21.4
New Jersey	54.3	53.1	34.3	41.6
New York State	49.9	34.5	32.6	22.8
North Carolina	43.5	64.3	27.9	53.2
Ohio	45.5	65.9	29.7	39.2
Oklahoma	46.6	41.2	31.5	24.3
Oregon	44.8	49.6	28.5	43.2
Pennsylvania	50.2	41.9	29.3	32.4
Puerto Rico ⁴	33.6	14.0	20.3	13.5
South Carolina	41.5	46.3	26.4	45.3
South Dakota	54.3	33.3	37.8	32.8
Tennessee	38.8	47.9	23.4	43.6
Texas	43.7	49.6	26.9	34.1
Virginia	49.9	55.4	29.8	39.7
Washington	47.8	26.3	31.2	25.6
West Virginia	41.7	51.8	30.4	34.0
Wisconsin	40.6	41.9	30.1	16.3

¹ Includes BOP-managed institutions and administrative offices only; excludes Residential Reentry Centers and institutions managed by private entities.

² State/territory-level vaccination coverage for the overall adult population was downloaded from the CDC COVID Data Tracker website and may include some BOP staff and/or people incarcerated in BOP institutions in that state/territory.

³ State/territory-level vaccination coverage for the BOP population includes both staff and people incarcerated in BOP institutions in a given state or territory.

⁴ BOP operates one institution in Puerto Rico. Because this institution is a Federal Detention Center, it was allocated Janssen/Johnson & Johnson vaccine for incarcerated people, who are assigned to the institution for an uncertain period of time and may not be present long enough to receive a 2-dose vaccine series. The first shipment of vaccine intended for incarcerated people was delayed en route; by the time it had been delivered, the federal government had paused administration of Janssen vaccine.

⁵ BOP vaccination coverage in Washington, DC reflects staff only, because there are no BOP institutions located there. The BOP Central Office is the only BOP site located in Washington, DC.

tion, number of medical conditions associated with severe COVID-19 illness, and institution type as independent variables; all variables were independently associated with vaccination acceptance, and the model was not reduced further. Odds of vaccination acceptance increased with age and number of medical conditions associated with severe COVID-19 illness; having a prior SARS-CoV-2 infection was also associated with vaccination acceptance (aOR = 1.08, 95% CI = 1.05, 1.12). There were significant differences in vaccination acceptance by sex and race/ethnicity, with females (aOR = 0.60, 95% CI = 0.53, 0.67) less likely to accept vaccination compared with males, and non-Hispanic Black people (aOR = 0.43, 95% CI = 0.41, 0.44) and Asian people (aOR = 0.79, 95% CI = 0.68, 0.91) less likely to accept vaccination compared with non-Hispanic White people. People born outside of the United States (aOR = 1.42, 95% CI = 1.34, 1.51) or with an unknown country of birth (aOR = 1.42, 95% CI = 1.14, 1.77) were more likely to accept vaccination compared with people born in the United States. Institution type was also significant, with people assigned to Federal Detention Centers more likely to accept vaccination

compared with people assigned to medium-security prisons (aOR = 1.96, 95% CI = 1.30, 2.94).

3.4. COVID-19 vaccination coverage among BOP staff

As of April 14, 2021, BOP had offered COVID-19 vaccination to 37,870 (100%) staff, and 19,024 (50.2%) accepted. A total of 19,024 (50.2%) staff had received at least one dose, and 17,880 (47.2%) had been fully vaccinated through the BOP workplace vaccination campaign.

3.5. COVID-19 vaccination coverage in BOP vs. overall adult population by state/territory

Table 4 compares COVID-19 vaccination coverage in BOP (staff and incarcerated people combined) versus the overall adult population in each state/territory that contains a BOP institution and/or office. Across these states/territories, 14.0–65.9% (median: 46.0%) of BOP staff and incarcerated populations had received at least

one vaccine dose, compared with 33.6–65.2% (median: 45.4%) of the overall adult population; 12.6–59.3% (median: 33.4%) of BOP staff and incarcerated populations had been fully vaccinated, compared with 20.3–37.8% (median: 29.5%) of the overall adult population.

4. Discussion

Within four months, the Federal Bureau of Prisons offered COVID-19 vaccination to 100% of staff and 69.8% of incarcerated people, with acceptance rates of 50.2% and 64.2%, respectively, and administered 95.9% of distributed vaccine doses. At the time of this analysis, COVID-19 vaccination coverage in BOP was comparable to coverage in the overall US adult population; 50.2% of BOP staff and 44.8% of incarcerated people had received at least one vaccine dose, and 47.2% and 29.9% had been fully vaccinated, respectively, compared with 47.0% of adults in the United States overall who had received at least one dose and 29.1% who had been fully vaccinated during the same time period [9]. In most states and territories that include a BOP institution and/or office, vaccination coverage in the BOP staff and incarcerated population was comparable to coverage in the overall adult population as well.

The COVID-19 vaccination acceptance rate among people incarcerated in BOP institutions is similar to the rate reported by the California state prison system (66.5%), and higher than an estimate of vaccination intent measured among people incarcerated across 16 prisons and jails in four states (45%) during a similar time period [10–11]. In addition, factors associated with vaccination acceptance in BOP are consistent with factors identified in these two studies; specifically, vaccination intent and acceptance in these correctional populations are consistently lower among non-Hispanic Black participants, younger adults, and women, and higher among non-Hispanic White participants [10–11]. Similar demographic trends have emerged from general population surveys of vaccination intent as well [12–13].

Potential contributors to the progress of the BOP COVID-19 vaccination program could include early access to vaccine through a dedicated federal allocation, early and ongoing consultation with CDC and the Federal Government COVID-19 Vaccine and Therapeutics Operation to prepare an implementable vaccination plan, full support from senior BOP leadership, close coordination between the BOP Vaccine Allocation Group and individual BOP institutions, and education provided to institution administrators and healthcare staff administering the vaccine as well as to staff and incarcerated people offered vaccination. The relative absence of patient-level barriers to vaccination in BOP compared with the general population could also contribute to BOP's level of vaccination coverage. For example, most people in the general population who wished to be vaccinated during this time period needed to actively monitor changing state vaccination eligibility requirements, navigate multiple healthcare provider websites to secure an appointment, and travel to the appointment, sometimes over long distances. By contrast, BOP staff and incarcerated people received an in-person, verbal vaccination offer from a healthcare provider, and vaccination occurred onsite. The availability of one-on-one education about the vaccine at the time of the vaccination offer may have improved vaccine confidence among those who intended to decline, and some people may have been encouraged to accept vaccination because they could see their peers being vaccinated. The availability of additional vaccination opportunities after the initial offer and the requirement for incarcerated people to sign a declination form if they chose not to be vaccinated may also have contributed to acceptance rates.

Even with these early successes, there are opportunities to further increase vaccination coverage in BOP. Potential strategies fall

into two categories, universal and tailored. One possible universal strategy is to continue offering vaccination to all incarcerated people who have declined; this analysis has demonstrated that approximately half of those with documentation of a second vaccination offer accepted it, without any further intervention designed to increase acceptance beyond the offer itself. Possible tailored strategies to increase coverage include designing vaccination education messages for people in specific subgroups that have thus far been less likely to accept vaccination, specifically non-Hispanic Black and Asian people, women, and younger, healthier people who may perceive themselves as having low risk for SARS-CoV-2 infection or severe COVID-19 illness. In addition, peer education programs where incarcerated people are trained to serve as educators have been successful in promoting participation in a variety of prevention, testing, and treatment programs for diseases such as hepatitis C and could be adapted for COVID-19 vaccination [14–15].

Tailored strategies may be especially important to promote vaccination in groups disproportionately affected by the COVID-19 pandemic. For example, vaccination messaging tailored toward Black incarcerated people could address reasons for vaccine hesitancy known to be common in some Black communities and could be delivered by Black healthcare providers or peer educators [16]. Because Black people are both disproportionately represented in incarcerated populations and less likely to accept COVID-19 vaccination (in both correctional settings and the community), increasing vaccination coverage among Black incarcerated people can contribute to health equity.

One novel finding in this report is a higher vaccination acceptance rate among incarcerated people assigned to Federal Detention Centers (used to hold people before and during trial) compared with other types of institutions. The only major difference in vaccination operations in Federal Detention Centers is their use of single-dose vaccines, chosen because of the unpredictable length of time that people remain in these facilities. Additional study could investigate whether higher acceptance rates in Federal Detention Centers reflect a preference for single-dose vaccines, and whether offering this option in other types of institutions could increase acceptance rates.

True vaccination coverage among BOP staff may be higher than what is reported here, because staff who have been vaccinated outside the BOP system are not included in these analyses. Even so, staff vaccination coverage could be further increased as well. To promote staff vaccination, BOP can consider similar universal and tailored strategies, re-offering vaccination to staff who have declined, using peer-to-peer education, and engaging trusted messengers to deliver information tailored to subsets of the staff population. Based on anecdotal reports, BOP institutions with higher vaccination coverage among staff have had internal vaccine “champions” who are known to be influencers in their peer groups, as well as strong support from their Wardens. Best practices have included setting up vaccination stations in high-traffic areas that are easily accessible to staff, scheduling one-on-one appointments with all staff members to answer questions about COVID-19 vaccines and to administer the vaccine to those who want it, and engaging a diverse group of staff to promote vaccination in their circles of influence.

At the time of this analysis, BOP policies regarding social distancing, masking, participation in group activities, SARS-CoV-2 diagnostic and screening testing, and movement between facilities did not differ based on individuals' vaccination status, in accordance with CDC guidance for correctional and detention facilities available at that time [4,5]. It is possible that the absence of a difference in the COVID-19-related restrictions placed on vaccinated versus unvaccinated incarcerated people has impeded vaccination efforts. CDC guidance for correctional and detention facilities

released in June 2021 allows COVID-19 prevention measures to be relaxed for fully vaccinated people (e.g., vaccinated people may resume in-person visitation and group programming with other fully vaccinated people), and these changes may help to increase vaccination demand [17].

These analyses are subject to at least five limitations. First, staff who were vaccinated outside the BOP system are not represented in the BOP VAMS module, resulting in an underestimate of vaccination coverage among directly-employed BOP staff. Second, the BOP COVID-19 vaccine allocation did not include contracted staff, further limiting the ability to estimate overall vaccination coverage among all staff working in BOP institutions. Third, demographic data characterizing staff overall versus the subset of staff who were vaccinated were collected using different variable categories or were missing for a large percentage of staff records, preventing a comparison between the two groups. Fourth, state/territorial vaccination coverage data for the overall adult population downloaded from the CDC COVID Data Tracker website include some data submitted by BOP. Although BOP data could not be removed from state/territorial totals, the BOP population represents too small a fraction of any state or territory's overall population to have a meaningful impact on the results of this analysis. Fifth, the percentage of incarcerated people who were offered vaccination a second time included only documented instances of second offers, typically made on an individual basis; non-targeted second offers made to groups of people during town hall announcements or on electronic message boards were not included.

5. Conclusions

High COVID-19 vaccination coverage is critical for BOP to protect staff and incarcerated people during the COVID-19 pandemic and to return to pre-pandemic operations. As of the date these analyses were conducted, vaccination had been offered to all staff and to approximately two-thirds of incarcerated people, and BOP had reached levels of vaccination coverage comparable to those in the overall United States adult population and in other correctional settings. To continue to increase vaccination coverage, BOP can provide additional vaccination opportunities to people who initially declined and can consider tailoring communication strategies to groups with lower acceptance rates.

Funding Source

This work did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

The authors are grateful for the contributions of Jason Gwinn from the BOP Office of Research and Evaluation, and Amanda Deering and Jeanne Ocampo from the BOP Health Services Division for data analytic and statistical support.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.vaccine.2021.08.045>.

References

- [1] Toblin RL, Hagan LM. COVID-19 case and mortality rates in the Federal Bureau of Prisons. *Am J Prev Med* 2021;S0749-3797(21):00119–127. <https://doi.org/10.1016/j.amepre.2021.01.019>.
- [2] Hagan LM, Williams SP, Spaulding AC, Toblin RL, Figlenski J, Ocampo J, et al. Mass testing for SARS-CoV-2 in 16 prisons and jails – Six jurisdictions, United States, April–May 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(33):1139–43. <https://doi.org/10.15585/mmwr.mm6933a3>.
- [3] Toblin RL, Cohen SI, Hagan LM. SARS-CoV-2 infection among correctional staff in the Federal Bureau of Prisons. *Am J Public Health* 2021;e1–e4. DOI: 10.2105/AJPH.2021.306237. Online ahead of print.
- [4] Centers for Disease Control and Prevention. Interim guidance on management of Coronavirus Disease 2019 (COVID-19) in correctional and detention facilities. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. Accessed April 14, 2021. <https://www.cdc.gov/coronavirus/2019-ncov/community/correction-detention/guidance-correctional-detention.html>
- [5] Centers for Disease Control and Prevention. Interim considerations for SARS-CoV-2 testing in correctional and detention facilities. Atlanta, GA: US Department of Health and Human Services, 2021. Accessed April 14, 2021. <https://www.cdc.gov/coronavirus/2019-ncov/community/correction-detention/testing.html>
- [6] Centers for Disease Control and Prevention. Underlying Medical Conditions Associated with High Risk for Severe COVID-19: Information for Healthcare Providers. Atlanta, GA: US Department of Health and Human Services; 2021. Accessed April 14, 2021. <https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-care/underlyingconditions.html>
- [7] Federal Bureau of Prisons. Population Statistics. Washington, DC: US Department of Justice; 2021. Accessed April 14, 2021. https://www.bop.gov/about/statistics/population_statistics.jsp
- [8] Federal Bureau of Prisons. Staff Statistics. Washington, DC: US Department of Justice; 2021. Accessed April 14, 2021. https://www.bop.gov/about/statistics/statistics_staff_ethnicity_race.jsp
- [9] Centers for Disease Control and Prevention. COVID Data Tracker. Atlanta, GA: US Department of Health and Human Services; 2021. Accessed April 14, 2021. <https://covid.cdc.gov/covid-data-tracker/#vaccinations>.
- [10] Chin ET, Leidner D, Ryckman T, Liu YE, Prince L, Alarid-Escudero F, et al. COVID-19 vaccine acceptance in California state prisons. *NEJM* 2021 May 12. <https://doi.org/10.1056/NEJM2105282>.
- [11] Stern MF, Piasecko AM, Strick LB, Rajeshwar P, Tyagi E, Dolovich S, et al. Willingness to receive a COVID-19 vaccination among incarcerated or detained persons in correctional and detention facilities—Four states, September–December 2020. *MMWR Morb Mortal Wkly Rep* 2021;70:473–7. <https://doi.org/10.15585/mmwr.mm7013a3>.
- [12] Szilagyi PG, Thomas K, Shah MD, Vizueta N, Cui Y, Vangala S, Kapteyn A. National trends in the U.S. public's likelihood of getting a COVID-19 vaccine—April 1 to December 8, 2020. *JAMA* 2020;325:396–8. DOI: 10.1001/jama.2020.26419.
- [13] Nguyen KH, Srivastava A, Razzaghi H, Williams W, Lindley MC, Jorgensen C, et al. COVID-19 vaccination intent, perceptions, and reasons for not vaccinating among groups prioritized for early vaccination—United States, September and December 2020. *MMWR Morb Mortal Wkly Rep* 2021;70:217–22. <https://doi.org/10.15585/mmwr.mm7006e3>.
- [14] Crowley D, Murtagh R, Cullen W, Keevans M, Laird E, McHugh T, et al. Evaluating peer-supported screening as a hepatitis C case-finding model in prisoners. *Harm Reduction Journal* 2019;16:42. <https://doi.org/10.1186/s12954-019-0313-7>.
- [15] Thornton K, Sedillo ML, Kalishman S, Page K, Arora S. The New Mexico Peer Education Project: Filling a Critical Gap in HCV Prison Education. *J Health Care Poor Underserved* 2018;29:1544–57. <https://doi.org/10.1353/hpu.2018.0111>.
- [16] McDougale L, Hewlett D, Hutchins SS, Hood RG, Butler LM, Lang LK, et al. Serving as trusted messengers about COVID-19 vaccines and therapeutics. *J Natl Med Assoc* 2021;113(1):6–7. <https://doi.org/10.1016/j.jnma.2021.01.003>.
- [17] Centers for Disease Control and Prevention. Interim guidance on management of Coronavirus Disease 2019 (COVID-19) in correctional and detention facilities. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. Accessed June 10, 2021. <https://www.cdc.gov/coronavirus/2019-ncov/community/correction-detention/guidance-correctional-detention.html>