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Introduction: People living in correctional facilities are at high risk for contracting COVID-19. To characterize the burden of COVID-19 in the Federal Bureau of Prisons, inmate testing, case, and mortality rates are calculated and compared with those of the U.S.

Methods: Federal Bureau of Prisons data were derived from its inmate management system and a Federal Bureau of Prisons COVID-19–specific database. U.S. data were derived from the Centers for Disease Control and Prevention and the U.S. Census. Data were aggregated from February to September 2020 and accessed in September and November 2020. Testing rates were calculated for both the Federal Bureau of Prisons and the U.S. Case and infection fatality rates were calculated overall and by institution and compared with those of the U.S. An age- and sex-standardized mortality ratio was calculated.

Results: The Federal Bureau of Prisons tested more than half of its inmates (50.3%); its crude case and mortality rates were 11,710.1 and 77.4 per 100,000, respectively. Compared with the U.S., the case ratio was 4.7, and the standardized mortality ratio was 2.6. The infection fatality rate for both the Federal Bureau of Prisons and the U.S. was 0.7%. Among institutions that tested \( \geq 85\% \) of inmates, the combined infection fatality rate was 0.8% and ranged from 0.0% to 3.0%.

Conclusions: The Federal Bureau of Prisons COVID-19 case rates and standard mortality ratio were approximately 5 and 2.5 times those in U.S. adults, respectively, consistent with those of prisons nationwide. High testing rates and standardized death reporting could result in a more accurate infection fatality rate in the Federal Bureau of Prisons than in the U.S. Testing and other mitigation strategies, including reducing the population, have likely prevented further transmission and mortality in the Federal Bureau of Prisons.

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The COVID-19 case (laboratory confirmed and probable) and testing data in the BOP and U.S. population (inclusive of BOP) were aggregated from February 29 through September 23, 2020 using a COVID-19—specific data set for BOP and Centers for Disease Control and Prevention (CDC) data, respectively. BOP deaths were also aggregated through September 23; CDC mortality data were aggregated through September 26 (the week including September 23).5,6 Data were accessed on September 24, 2020 except for U.S. deaths, which were accessed on November 25, 2020. BOP’s IRB deemed this study as exempt and reviewed this paper.

BOP and U.S. COVID-19 testing rates were calculated to account for disease burden from asymptomatic cases and provide context for case rates. BOP testing rates were calculated overall and by institution as the proportion of inmates with a returned test. BOP tests inmates with signs and symptoms of COVID-19; tests close contacts of case patients; and tests inmates upon intake, transfer, or release; some institutions have performed mass testing.7,8 U.S. testing rates include multiple tests for some individuals; thus, the exact number of individuals tested is unknown.

To compare the crude case rates between BOP, which only houses adults, and the U.S., the proportion of case patients aged 0–17 years (8.4%)3 were subtracted from U.S. case patients. The overall BOP infection fatality rate (IFR) was calculated as the number of deaths among patients with COVID-19 and was compared with a meta-analysis of the U.S. IFR that included children.9 To account for BOP’s asymptomatic cases, the IFR was also calculated collectively and individually for institutions that tested >85% of inmates relative to its February 29, 2020 census.

To account for substantial differences in age and sex distributions in the BOP and U.S. adult populations (variables associated with differential COVID-19 mortality), an age- and sex-adjusted standardized mortality ratio (SMR) was calculated by comparing BOP deaths with CDC COVID-19 mortality counts by age and sex4 referenced against the U.S. Census counts. Analyses were conducted in Excel 2016.

**RESULTS**

Most BOP inmates were male (92.5%), U.S. citizens (87.5%), and young (3.7% were aged ≥65 years relative to 17.0% in the U.S.) with a greater proportion of racial/ethnic minorities compared with the U.S. population (Table 1). As of September 23, 2020, in total, 50.3% of BOP inmates and 32.5% of the U.S. population (assuming 1 test per person) had been tested for COVID-19. The crude case rates for BOP and U.S. adults were 11,710.1 and 2,484.4 cases per 100,000 people, respectively, a ratio of 4.7. The crude mortality rates were 77.4 and 80.5 per 100,000 people, a ratio of 1.0 (Appendix Table 1, available online). The crude IFR for both the BOP and U.S.5 was 0.7%. Deaths occurred in 23.8% of BOP institutions. Appendix Table 2 (available online) displays institution-specific COVID-19 cases and deaths for the 25 institutions that tested ≥85% of inmates relative to their February 29 census. These institutions represented 19.9% of the overall BOP population and had a case rate of 33,189.8 per 100,000 people, 2.8 times that of the overall BOP. For these institutions, the combined IFR was 0.8% (range=0.0%−3.0%, median=0.3%, IQR=0.0%−1.0%).

Table 2 shows the age- and sex-specific SMRs for the BOP. BOP inmates were 2.6 times as likely to die from COVID-19 as U.S. adults (male SMR=2.5, female SMR=4.6).

**DISCUSSION**

These findings update and augment an earlier study that presented aggregated COVID-19 cases and deaths in state and federal prisons; this study uses more recent federal data and includes testing data, IFRs, and institution-specific information. The high BOP case rate relative to that of U.S. adults may be attributed to close contact within congregate living environments, combined with numerous opportunities for COVID-19 introduction from staff with community-acquired infections, new intakes from other jurisdictions, and inmates with hospital-acquired infections.5 BOP’s high testing rate (>50%) may also contribute to the high case rate. Testing as a mitigation strategy has allowed BOP to identify and isolate cases and quarantine their close contacts as recommended by CDC,7 likely preventing further transmission and mortality.

At 0.7%, the overall BOP IFR is the same as that in the U.S.6 The IFR among BOP institutions with the highest

### Table 1. Demographic Characteristics of BOP and the U.S.

| Characteristics | BOP, % | U.S., b, % |
|----------------|--------|------------|
| U.S. citizenship | 87.5 | 92.2 c |
| Male sex | 92.5 | 48.7 |
| Aged ≥65 years | 3.5 | 17.0 |
| Race/ethnicity | | |
| Hispanic | 26.1 | 18.3 |
| Non-Hispanic Asian American | 1.5 | 5.6 |
| Non-Hispanic Black | 38.9 | 12.3 |
| Non-Hispanic American Indian, Alaska Native, Hawaiian Native or Pacific Islander | 2.5 | 0.9 |
| Non-Hispanic White | 31.1 | 60.2 |

aBOP data were from February 29, 2020 before any COVID-19 cases or related inmate releases; U.S. data were from the U.S. Census 2018 American Community Survey.
bAmong adults only to compare with BOP, which only houses adults; U.S. race/ethnicity data were only available for all ages.
cDerived by dividing the total number of citizens aged 18 years and over population table by the total number in the 18 years and over section within the age- and sex-stratified tables of the total U.S. population.
dCensus data included an option for ≥2 races, whereas BOP did not, so the U.S. data do not total to 100%.eBOP, Federal Bureau of Prisons.

### Appendix Table 1

Demographic Characteristics of BOP and the U.S.

| Race/ethnicity | BOP, % | U.S., b, % |
|----------------|--------|------------|
| White | 92.5 | 48.7 |
| Black | 38.9 | 12.3 |
| Asian | 2.5 | 0.9 |
| Hispanic | 26.1 | 18.3 |
| American Indian, Alaska Native, Hawaiian Native or Pacific Islander | 2.5 | 0.9 |
| White | 31.1 | 60.2 |

bNon-Hispanic Black | 38.9 | 12.3 |
| Non-Hispanic Asian American | 1.5 | 5.6 |
| Non-Hispanic White | 31.1 | 60.2 |

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testing rates (i.e., ≥85%) was 0.8%. BOP’s higher testing rate overall, and especially in these institutions, may account for more asymptomatic cases than that seen in U.S. testing, potentially resulting in a more accurate estimate of total infections than in the U.S. In addition, BOP’s standardized death reporting system likely results in less under-reporting of COVID-19–related deaths than the U.S. mortality systems that are not standardized. Both factors could result in a higher degree of accuracy in the BOP IFR than in the U.S. IFR.

After adjusting for age and sex differences, the overall BOP SMR of 2.6 is consistent with the findings of a previous study of prisons nationwide. All female deaths but one occurred during an outbreak in a single institution housing female inmates with medical comorbidities, potentially contributing to the higher female-specific SMR; the small numbers make interpretation challenging. Higher age- and sex-adjusted mortality from COVID-19 in BOP likely reflects the high rates of underlying health conditions, especially at younger ages, which increase the risk of severe illness from COVID-19. One way BOP addressed this was by decreasing its population by 13.4% through reduced intakes and releases to the community, residential re-entry centers, and home confinement to protect inmates at the highest risk for COVID-19 if deemed to be a low risk to public safety.

Limitations
This study has 4 limitations. First, institution-specific testing rates relied on prepandemic censuses, although censuses shifted throughout the pandemic owing to releases and inmate movement to reduce institution density. Second, tests given to inmates in hospitals were excluded. Third, U.S. testing rates and the IFR include children. Taken together, these measurement biases could underestimate BOP testing rates (and overestimate BOP’s IFR) and overestimate U.S. adult testing rates (and underestimate the U.S. adult IFR). Fourth, the calculation of BOP’s SMR did not control for the high rates of underlying health conditions or racial and ethnic differences in correctional populations relative to those in the U.S. population, which are associated with differential COVID-19 mortality.

| Age group, years | U.S. COVID-19 deaths | U.S. age distribution | BOP age distribution | Expected BOP COVID-19 deaths | Observed BOP COVID-19 deaths | Standardized mortality ratio |
|------------------|----------------------|-----------------------|----------------------|-----------------------------|----------------------------|-----------------------------|
| Male             |                      |                       |                      |                             |                            |                             |
| 18–24            | 227                  | 15,546,666            | 5,891                | 0.1                         | 0                          | 0.0                         |
| 25–34            | 1,071                | 23,162,842            | 37,116               | 1.7                         | 0                          | 0.0                         |
| 35–44            | 2,850                | 20,554,443            | 46,367               | 6.4                         | 6                          | 0.9                         |
| 45–54            | 7,474                | 20,514,573            | 28,092               | 10.2                        | 14                         | 1.4                         |
| 55–64            | 16,990               | 20,377,611            | 12,251               | 10.2                        | 39                         | 3.8                         |
| 65–74            | 27,077               | 14,225,362            | 4,672                | 8.9                         | 26                         | 2.9                         |
| ≥75              | 54,689               | 9,055,733             | 689                  | 4.2                         | 21                         | 5.0                         |
| Total            | 110,378              | 123,437,230           | 135,078              | 41.7                        | 106                        | 2.5                         |
| Female           |                      |                       |                      |                             |                            |                             |
| 18–24            | 139                  | 14,826,812            | 625                  | 0.0                         | 0                          | 0.0                         |
| 25–34            | 556                  | 22,447,268            | 3,232                | 0.1                         | 1                          | 12.5                        |
| 35–44            | 1,342                | 20,659,031            | 3,608                | 0.2                         | 2                          | 8.5                         |
| 45–54            | 3,524                | 21,063,133            | 2,186                | 0.3                         | 1                          | 2.7                         |
| 55–64            | 9,250                | 21,846,638            | 977                  | 0.4                         | 2                          | 4.8                         |
| 65–74            | 17,104               | 16,223,821            | 311                  | 0.3                         | 1                          | 3.0                         |
| ≥75              | 61,680               | 12,864,423            | 19                   | 0.1                         | 0                          | 0.0                         |
| Total            | 93,595               | 129,931,126           | 10,958               | 1.4                         | 7                          | 4.6                         |
| All sexes        |                      |                       |                      |                             |                            |                             |
| Total            | 203,973              | 253,368,356           | 146,036              | 43.3                        | 113                        | 2.6                         |

aBOP deaths were through September 23, 2020; U.S. data were through the closest weekly update, which was posted on September 23, 2020 and ended on September 26, 2020.
bU.S. Census data were from July 1, 2018, the same date CDC uses for population estimates.
cBOP data were from February 29, 2020 before any BOP COVID-19 cases or related inmate releases.
BOP, Federal Bureau of Prisons; CDC, Centers for Disease Control and Prevention.
CONCLUSIONS
The COVID-19 case rates and SMR for inmates were approximately 5 and 2.5 times those in U.S. adults, respectively, consistent with those of prisons nationwide. Mitigation strategies, including increased testing, cleaning and disinfecting, personal protective equipment and facial coverings, social distancing, reducing the population, and movement of inmates to reduce institution density, have likely prevented further transmission and mortality. Continued enhanced surveillance and adherence to updated infection control and testing guidance specific to correctional populations, vaccine distribution planning, and consideration of other mitigation strategies could further reduce the impact of COVID-19 in the BOP population.

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SUPPLEMENTAL MATERIAL
Supplemental materials associated with this article can be found in the online version at https://doi.org/10.1016/j.amepre.2021.01.019.

REFERENCES
1. Montoya-Barthelemy AG, Lee CD, Cundiff DR, Smith EB. COVID-19 and the correctional environment: the American prison as a focal point for public health. Am J Prev Med. 2020;58(6):888–891. https://doi.org/10.1016/j.amepre.2020.04.001.
2. Saloner B, Parish K, Ward JA, DiLaura G, Dolovich S. COVID-19 cases and deaths in federal and state prisons. JAMA. 2020;324(6):602–603. https://doi.org/10.1001/jama.2020.12528.
3. COVID data tracker. Centers for Disease Control and Prevention. https://covid.cdc.gov/covid-data-tracker/. Updated March 24, 2021. Accessed September 24, 2020.
4. Weekly updates by select demographic and geographic characteristics: provisional death counts for coronavirus disease 2019 (COVID-19). Centers for Disease Control and Prevention. https://www.cdc.gov/nchs/nvss/vsrr/covid_weekly/index.htm?AgeAndSex. Updated March 24, 2021. Accessed November 25, 2020.
5. Hagan LM, Williams SP, Spaulding AC, 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):1139–1143. https://doi.org/10.15585/mmwr.mm6933a3.
6. Meyerowitz-Katz G, Merone L. A systematic review and meta-analysis of published research data on COVID-19 infection fatality rates. Int J Infect Dis. 2020;101:138–148. https://doi.org/10.1016/j.ijid.2020.09.1464.
7. Interim guidance on management of coronavirus disease 2019 (COVID-19) in correctional and detention facilities. Centers for Disease Control and Prevention. https://www.cdc.gov/coronavirus/2019-ncov/community/correction-detention/guidance-correctional-detention.html. Updated February 19, 2021. Accessed November 25, 2020.
8. Woolf SH, Chapman DA, Sabo RT, Weinberger DM, Hill L, Taylor DDH. Excess deaths from COVID-19 and other causes, March-July 2020. JAMA. 2020;324(15):1562–1564. https://doi.org/10.1001/jama.2020.19545.