Shelter Characteristics, Infection Prevention Practices, and Universal Testing for SARS-CoV-2 at Homeless Shelters in 7 US Urban Areas

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See also the COVID-19/Public Health Preparedness and Response section, pp. 842–875.

Objectives. To examine shelter characteristics and infection prevention practices in relation to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection point prevalence during universal testing at homeless shelters in the United States.

Methods. SARS-CoV-2 testing was offered to clients and staff at homeless shelters, irrespective of symptoms. Site assessments were conducted from March 30 to June 1, 2020, to collect information on shelter characteristics and infection prevention practices. We assessed the association between SARS-CoV-2 infection prevalence and shelter characteristics, including 20 infection prevention practices by using crude risk ratios (RRs) and exact unconditional 95% confidence intervals (CIs).

Results. Site assessments and SARS-CoV-2 testing results were reported for 63 homeless shelters in 7 US urban areas. Median infection prevalence was 2.9% (range = 0%–71.4%). Shelters implementing head-to-toe sleeping and excluding symptomatic staff from working were less likely to have high infection prevalence (RR = 0.5; 95% CI = 0.3, 0.8; and RR = 0.5; 95% CI = 0.4, 0.6; respectively); shelters with medical services available were less likely to have very high infection prevalence (RR = 0.5; 95% CI = 0.2, 1.0).

Conclusions. Sleeping arrangements and staffing policies are modifiable factors that might be associated with SARS-CoV-2 infection prevalence in homeless shelters. Shelters should follow recommended practices to reduce the risk of SARS-CoV-2 transmission. (*Am J Public Health.* 2021;111:854–859. https://doi.org/10.2105/AJPH.2021.306198)

Homeless shelters provide temporary and emergency housing for people experiencing homelessness. People experiencing homelessness disproportionately experience untreated chronic medical conditions, older age, and barriers to accessing medical care,[1] increasing the risk of severe disease from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus that causes COVID-19.[2] Furthermore, as shelters are often congregate settings where it can be challenging to adhere to Centers for Disease Control and Prevention (CDC) guidance to reduce SARS-CoV-2 transmission, such as hand-washing, wearing face masks, or remaining at least 6 feet apart, exposure risk might also be increased.[3]

COVID-19 cases have been detected among clients and staff at US homeless shelters.[4–6] A previous study of shelters in 4 US cities identified varied SARS-CoV-2 infection prevalence using universal testing, defined as offering testing irrespective of symptoms.[5] This strategy can inform isolation efforts and infection prevalence estimations because it identifies more cases, including asymptomatic and presymptomatic cases, compared with symptom-based testing alone.[6]

Homeless shelters vary widely in access to resources, operational plans, regulations, size, staffing, and populations served, but the extent to which

these traits affect SARS-CoV-2 infection prevalence is unknown. To support shelters during the COVID-19 pandemic, it is critical to identify shelter characteristics with potential to mitigate transmission among clients and staff. In this analysis, we examined shelter characteristics and infection prevention practices in relation to SARS-CoV-2 infection point prevalence at shelters where universal testing occurred.

METHODS

As part of the response to the COVID-19 pandemic, CDC requested collaboration from health and housing partners in 7 US urban areas where universal testing had been performed at shelters during April 1 to June 1, 2020. Participating agencies provided data from site assessments and universal testing.

Universal SARS-CoV-2 testing was conducted per local protocols by real-time reverse transcription–polymerase chain reaction, proactively or in response to a positive viral test at the shelter. Although universal testing was uncommon for the general population, all clients and staff were offered testing; participation was voluntary. If multiple testing events occurred at a shelter, only results of the first event were included. Prevalence was estimated by dividing the number of clients and staff positive for SARS-CoV-2 by the total tested.

Health or housing professionals conducted site assessments to collect information about shelter characteristics and infection prevention practices using a template adapted for local needs (Appendix A, available as a supplement to the online version of this article at https://www.ajph.org). Shared data elements included information about client sleeping arrangements, staffing practices and training, and infection

prevention practices such as symptom screening and face mask use. County population density was calculated as inhabitants per square mile,[7] and COVID-19 incidence (cases per 100 000 per week)[8] was estimated as a 7-day average encompassing 3 days before to 3 days after testing.

Infection prevalence greater than 2.9% (the median) was defined as "high" and compared with prevalence of less than or equal to 2.9%; the subset greater than 10% was defined as "very high" and compared with prevalence of less than or equal to 10%. Other continuous variables were converted to binary variables based on the median. We calculated crude risk ratios (RRs) and exact unconditional 95% confidence intervals (CIs) to assess for associations between high or very high prevalence and shelter characteristics. We conducted analyses in SAS version 9.4 (SAS Institute, Cary, NC).

RESULTS

SARS-CoV-2 testing results and site assessments conducted March 30 through June 1, 2020, were reported for 63 shelters in urban areas in 7 states (California, Colorado, Georgia, Illinois, Nevada, Rhode Island, and Washington). Site assessments were conducted a median of 13 days after the testing event (range = 1 day before to 51 days after). Among 20 infection prevention practices included in this report, 19 (95%) were implemented by greater than 50% and 9 (45%) by greater than 80% of shelters (Table 1).

The average number of beds filled ranged from 8 to 320 (median = 74). The number of clients and staff members tested ranged from 7 to 364 (median = 63), and the number that tested positive for SARS-CoV-2 ranged

from 0 to 165 (median = 2). Median prevalence by facility was 2.9% (range = 0%–71.4%). Twenty (31.7%) shelters had very high (> 10%) prevalence.

Shelters implementing head-to-toe sleeping (positioning beds in a row so that clients sleep with heads at alternating ends of the bed compared with their neighbors [i.e., each client's head lines up with their neighbors' toes, to maximize distance between clients' heads and minimize sharing air space while sleeping]) were less likely to experience high infection prevalence (35.1%; 13 of 37) compared with shelters that did not implement head-to-toe sleeping (73.7%; 14 of 19; RR = 0.5; 95% CI = 0.3, 0.8). Shelters that excluded symptomatic staff were also less likely to experience high prevalence (47.5%; 29 of 61) compared with shelters allowing symptomatic staff to continue working (100%; 2 of 2; RR = 0.5; 95% CI = 0.4, 0.6). Shelters with on-site medical services were less likely to have very high prevalence (20.6%; 7 of 34) compared with shelters lacking those services (44.8%; 13 of 29; RR = 0.5; 95% CI = 0.2, 1.0). In this analysis, additional characteristics (e.g., staff training, client and staff symptom screening and face mask use, and county COVID-19 incidence) were not associated with prevalence (Table 1).

DISCUSSION

These data show that universal testing at homeless shelters can identify high prevalence of SARS-CoV-2 infection, even in areas with low incidence of COVID-19, and shelters have adopted a range of infection prevention practices. Adopting head-to-toe sleeping arrangements and excluding symptomatic shelter staff from working were associated with lower risk of high SARS-CoV-2

TABLE 1— Association of High Point Prevalence During Universal SARS-CoV-2 Testing at Homeless Shelters, Selected County and Shelter Characteristics: 7 US Urban Areas, March 30–June 1, 2020

	Total Shelters, No. (%)[a] or Median (Range)	High SARS-CoV-2 Infection Prevalence,[b] No. (%) or Median (Range)	RR (95% CI)	Very High SARS-CoV-2 Infection Prevalence,[c] No. (%)	RR (95% CI)
Total	63	31 (49.2)		20 (31.7)	
County-level characteristics					
COVID-19 incidence (cases per 100 000)					
High, > 15 (Ref)	30 (47.6)	17 (60.7)		12 (42.9)	
Low, ≤ 15	33 (52.4)	14 (40.0)	0.7 (0.5, 1.2)	8 (22.9)	0.6 (0.3, 1.3)
Median	15.0 (2.9–32.8)				
Population density (inhabitants per square mile)					
High, > 3 923 (Ref)	31 (49.2)	18 (58.1)		13 (41.9)	
Low, ≤ 3 923	32 (50.8)	13 (40.6)	0.7 (0.4, 1.2)	7 (21.9)	0.5 (0.2, 1.1)
Median	3 923 (247–17 179)				
Client sleeping arrangements					
Percentage of beds filled					
≥ 74 (Ref)	31 (49.2)	14 (45.2)		8 (25.8)	
< 74	29 (29)	16 (55.2)	1.2 (0.7, 2.0)	12 (41.4)	1.6 (0.8, 3.4)
Median	76.9 (15.4–125)				
Beds or mats assigned to 1 person (instead of shared or communal use)					
No (Ref)	7 (11.1)	4 (57.1)		3 (42.9)	
Yes	53 (84.1)	26 (49.1)	0.9 (0.4, 1.7)	17 (32.1)	0.7 (0.3, 1.9)
Distance between beds in sleeping area ≥ 3 feet					
No (Ref)	10 (15.9)	6 (60.0)		4 (40.0)	
Yes	51 (81.0)	24 (47.1)	0.8 (0.4, 1.4)	15 (29.4)	0.7 (0.3, 1.8)
Separation screen or barrier between beds					
No (Ref)	50 (79.4)	25 (50.0)		15 (30.0)	
Yes	10 (15.9)	5 (50.0)	1.0 (0.5, 2.0)	4 (40.0)	1.3 (0.6, 3.2)
Clients sleeping head-to-toe					
No (Ref)	19 (30.2)	14 (73.7)		10 (52.6)	
Yes	37 (58.7)	13 (35.1)	0.5 (0.3, 0.8)	8 (21.6)	0.4 (0.2, 0.9)
Staff characteristics and training					
Staff work at other shelter locations					
No (Ref)	35 (55.6)	18 (51.4)		11 (31.4)	
Yes	23 (36.5)	12 (52.2)	1.0 (0.6, 1.7)	9 (39.1)	1.2 (0.6, 2.5)
Medical services routinely available at the facility					
No (Ref)	29 (46.0)	17 (58.6)		13 (44.8)	
Yes	34 (54.0)	14 (41.2)	0.7 (0.4, 1.2)	7 (20.6)	0.5 (0.2, 1.0)
All staff trained on hygiene measures and standard precautions					
No (Ref)	4 (6.3)	1 (25.0)		1 (25.0)	
Yes	58 (92.1)	29 (50.0)	2.0 (0.4, 11.1)	18 (31.0)	1.2 (0.2, 7.1)

Continued

TABLE 1— Continued

	Total Shelters, No. (%)[a] or Median (Range)	High SARS-CoV-2 Infection Prevalence,[b] No. (%) or Median (Range)	RR (95% CI)	Very High SARS-CoV-2 Infection Prevalence,[c] No. (%)	RR (95% CI)
All staff received training on how to correctly put on and take off personal protective equipment					
No (Ref)	14 (22.2)	6 (42.9)		5 (35.7)	
Yes	42 (66.7)	21 (50.0)	1.2 (0.6, 2.3)	14 (33.3)	0.9 (0.4, 2.1)
Staff routinely wear masks when interacting with clients					
No (Ref)	5 (7.9)	2 (40.0)		2 (40.0)	
Yes	54 (85.7)	27 (50.0)	1.3 (0.4, 3.8)	17 (31.5)	0.8 (0.3, 2.5)
All staff screened for symptoms					
No (Ref)	23 (36.5)	11 (47.8		8 (34.8)	
Yes	39 (61.9)	19 (48.7)	1.0 (0.6, 1.7)	11 (28.2)	0.8 (0.4, 1.7)
All staff have their temperature checked					
No (Ref)	25 (39.7)	12 (48.0)		9 (36.0)	
Yes	34 (54.0)	16 (47.1)	1.0 (0.6, 1.7)	10 (29.4)	0.8 (0.4, 1.7)
Staff excluded from working when symptomatic					
No (Ref)	2 (3.2)	2 (100)		1 (50.0)	
Yes	61 (96.8)	29 (47.5)	0.5 (0.4, 0.6)	19 (31.1)	0.6 (0.1, 2.6)
Other infection prevention practices					
Limited number of designated entry points					
No (Ref)	2 (3.2)	1 (50.0)		1 (50.0)	
Yes	61 (96.8)	30 (49.2)	1.0 (0.2, 4.0)	19 (31.1)	0.6 (0.1, 2.6)
Handwashing available at facility entry					
No (Ref)	22 (34.9)	11 (50.0)		6 (27.3)	
Yes	39 (61.9)	18 (46.2)	0.9 (0.5, 1.6)	12 (30.8)	1.1 (0.5, 2.6)
Points of entry monitored to ensure hand hygiene					
No (Ref)	14 (22.2)	6 (42.9)		4 (28.6)	
Yes	44 (69.8)	23 (52.3)	1.2 (0.6, 2.4)	15 (34.1)	1.2 (0.5, 3.0)
Clients routinely wear masks or cloth face coverings when not in their sleeping areas					
No (Ref)	11 (17.5)	5 (45.5)		3 (27.3)	
Yes	46 (73.0)	24 (52.2)	1.1 (0.6, 2.3)	16 (34.8)	1.3 (0.4, 3.6)
All clients screened for symptoms					
No (Ref)	7 (11.1)	4 (57.1)		2 (28.6)	
Yes	54 (85.7)	26 (48.1)	0.8 (0.4, 1.7)	17 (31.5)	1.1 (0.3, 3.8)
All clients have their temperature checked					
No (Ref)	19 (30.2)	9 (47.4)		6 (31.6)	
Yes	44 (69.8)	22 (50.0)	1.1 (0.6, 1.8)	14 (31.8)	1.0 (0.5, 2.2)
Designated area for suspected cases or symptomatic clients to isolate					
No (Ref)	20 (31.7)	12 (60.0)		9 (45.0)	
Yes	43 (68.3)	19 (44.2)	0.7 (0.5, 1.2)	11 (25.6)	0.6 (0.3, 1.1)

Continued

TABLE 1— Continued

	Total Shelters, No. (%)[a] or Median (Range)	High SARS-CoV-2 Infection Prevalence,[b] No. (%) or Median (Range)	RR (95% CI)	Very High SARS-CoV-2 Infection Prevalence,[c] No. (%)	RR (95% CI)
Symptomatic clients provided with a surgical mask					
No (Ref)	4 (6.3)	2 (50.0)		2 (50.0)	
Yes	55 (87.3)	28 (50.9)	1.0 (0.4, 2.8)	17 (30.9)	0.6 (0.2, 1.8)

Note. CI = confidence interval; RR = risk ratio; SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2. For additional information about recommended prevention practices in homeless shelters, homeless service providers are encouraged to refer to the Centers for Disease Control and Prevention's Interim Guidance for Homeless Service Providers to Plan and Respond to Coronavirus Disease 2019 (COVID-19)[9] and resources to support people experiencing homelessness: https://www.cdc.gov/coronavirus/2019-ncov/community/homeless-shelters.

[a]Numbers may not equal 100% because of missing or unknown responses.
[b]High SARS-CoV-2 infection prevalence is defined as point prevalence above the median (> 2.9%).
[c]Very high SARS-CoV-2 infection prevalence is defined as point prevalence > 10%.

infection prevalence. Positioning beds so clients sleep head-to-toe is recommended to reduce transmission of respiratory pathogens, including SARS-CoV-2.[9] Consistent with CDC recommendations for all persons, shelters should require staff who experience symptoms consistent with COVID-19 to isolate at home for at least 10 days since symptoms first appeared and until symptoms have improved, including at least 24 hours with no fever without taking fever-reducing medication.[10] Availability of on-site medical services was associated with lower risk of having very high prevalence of SARS-CoV-2 in clients and staff. Routine access to on-site medical services might enable shelters to quickly identify and isolate symptomatic clients or to identify and maintain appropriate infection prevention practices.

Although symptom and temperature screening were not associated with prevalence in this analysis, they remain fundamental measures to identify individuals with suspected COVID-19. Studies have shown that, given the potential for asymptomatic and presymptomatic transmission of SARS-CoV-2,[11] additional measures, including the use of face masks, can reduce the spread of

SARS-CoV-2.[12] A combination of multiple infection prevention strategies is necessary to reduce transmission of SARS-CoV-2.

These findings are subject to several limitations. The high proportion of adopted infection control practices is a positive finding, but low variability in shelter practices and small sample size limit the ability to assess for confounding or detect statistically significant associations between prevention measures and prevalence. Timing of infection control measures and site assessments varied relative to testing events; associations between shelter practices and prevalence might not be correlated. Data were collected early in the pandemic as guidance regarding testing evolved, and prevalence was calculated for clients and staff together because some sites were unable to separate those results. Site assessments varied between locations and included self-reported data. Finally, results are not generalizable and are subject to biases, including selection (i.e., which areas and shelters offered and which individuals accepted SARS-CoV-2 testing), recall, and social desirability (i.e., tendency to respond

favorably to site assessment questions).

PUBLIC HEALTH IMPLICATIONS

Congregate settings, such as homeless shelters, can pose risks for spread of communicable diseases such as COVID-19. However, continuing services for people experiencing homelessness is critical. Sleeping arrangements and staffing policies, such as excluding symptomatic staff and having medical services on site, are modifiable factors that might be associated with transmission of SARS-CoV-2 in shelters. Shelters should follow recommended practices[9] to reduce the risk of SARS-CoV-2 transmission, and further studies should evaluate environmental risks associated with transmission in congregate settings. *AJPH*

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HUMAN PARTICIPANT PROTECTION

This activity was determined by Centers for Disease Control and Prevention to be public health surveillance in accordance with 45 CFR Part 46.

REFERENCES

1. Lebrun-Harris LA, Baggett TP, Jenkins DM, et al. Health status and health care experiences among homeless patients in federally supported health centers: findings from the 2009 patient survey. *Health Serv Res*. 2013;48(3):992–1017. https://doi.org/10.1111/1475-6773.12009

2. Hsu HE, Ashe EM, Silverstein M, et al. Race/ethnicity, underlying medical conditions, homelessness, and hospitalization status of adult patients with COVID-19 at an urban safety-net medical center—Boston, Massachusetts, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(27):864–869. https://doi.org/10.15585/mmwr.mm6927a3

3. Centers for Disease Control and Prevention. Coronavirus disease 2019 (COVID-19): how to protect yourself & others. Available at: https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html. Accessed July 14, 2020.

4. Tobolowsky FA, Gonzales E, Self JL, et al. COVID-19 outbreak among three affiliated homeless service sites—King County, Washington, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(17):523–526. https://doi.org/10.15585/mmwr.mm6917e2

5. Mosites E, Parker EM, Clarke KEN, et al. Assessment of SARS-CoV-2 infection prevalence in homeless shelters—four US cities, March 27–April 15, 2020. *MMWR Morb Mortal Wkly Rep*. 2020;69(17):521–522. https://doi.org/10.15585/mmwr.mm6917e1

6. Baggett TP, Keyes H, Sporn N, Gaeta JM. Prevalence of SARS-CoV-2 infection in residents of a large homeless shelter in Boston. *JAMA*. 2020;323(21):2191–2192. https://doi.org/10.1001/jama.2020.6887

7. US Census Bureau. QuickFacts. Available at: https://www.census.gov/quickfacts/fact/table/US/PST045219. Accessed June 4, 2020.

8. USAFacts. Coronavirus locations: COVID-19 map by county and state. Available at: https://usafacts.org/visualizations/coronavirus-covid-19-spread-map. Accessed June 4, 2020.

9. Centers for Disease Control and Prevention. Interim guidance for homeless service providers to plan and respond to coronavirus disease 2019 (COVID-19). Available at: https://www.cdc.gov/coronavirus/2019-ncov/community/homeless-shelters/plan-prepare-respond.html#coalition. Accessed June 23, 2020.

10. Centers for Disease Control and Prevention. Coronavirus disease 2019 (COVID-19): isolate if you are sick. Available at: https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/isolation.html. Accessed July 22, 2020.

11. Furukawa NW, Brooks JT, Sobel J. Evidence supporting transmission of severe acute respiratory syndrome coronavirus 2 while presymptomatic or asymptomatic. *Emerg Infect Dis*. 2020;26(7):e201595. https://doi.org/10.3201/eid2607.201595

12. Leung NHL, Chu DKW, Shiu EYC, et al. Respiratory virus shedding in exhaled breath and efficacy of face masks [erratum in *Nat Med*. 2020;26(6):981]. *Nat Med*. 2020;26(5):676–680. https://doi.org/10.1038/s41591-020-0843-2