Screening for co-infections in patients with substance use disorders and severe bacterial infections

Cara D. Varley, Michael Conte, Amber C. Streifel, Bradie Winders and Monica K. Sikka

Abstract

Background: Patients with substance use disorders admitted for severe bacterial infection are in a prime position to be screened for important co-infections. However, data suggest that standard screening for co-infections in this population during hospital admission can vary in frequency and type of testing.

Methods: We performed a retrospective review of patients to evaluate screening for co-infections during admission, followed by a case–control analysis to determine factors associated with lack of any screening.

Results: We identified 280 patients with 320 eligible admissions. Most were male and Caucasian with unstable housing. Only 67 (23.9%) patients had a primary-care provider. About 89% \((n = 250)\) of our cohort were screened for one or more co-infection during their first admission with one patient never screened despite subsequent admissions. Of those screened, the greatest proportion was HIV \((219, 81.4\%)\) of those without history of HIV, HCV \((94, 79.7\%)\) of those without a prior positive HCV antibody, syphilis \((206, 73.6\%)\), gonorrhea, and chlamydia \((47, 16.8\%)\) with new positive tests identified in 60 \((21.4\%)\) people. Screening for all five co-infections was only completed in 15 \((14.0\%)\) of the 107 patients who had screening indications. Overall, a high proportion of those screened had a new positive test, including three cases of neurosyphilis, highlighting the importance of screening and treatment initiation. One patient was prescribed HIV pre-exposure prophylaxis at discharge and only 37 \((34.6\%)\) of those eligible were referred for HCV treatment or follow-up. In multivariable case–control analysis, non-Medicaid insurance \((\text{OR} 2.8, 95\% \text{CI}: 1.2–6.6, p = 0.02)\), use of only 1 substance \((\text{OR} 2.9, 95\% \text{CI}: 1.3–6.5, p < 0.01)\), and no documented screening recommendations by the infectious disease team \((\text{OR} 3.7, 95\% \text{CI}: 1.5–8.8, p < 0.01)\), were statistically significantly associated with lack of screening for any co-infection during hospital admission.

Conclusion: Our data suggest additional interventions are needed to improve inpatient screening for co-infections in this population.

Keywords: chlamydia, gonorrhea, hepatitis C, human immunodeficiency virus, infection screening, injection drug use, substance use disorders, syphilis

Received: 8 March 2022; revised manuscript accepted: 23 September 2022.
**Methods**

We performed a retrospective review of patients age 18 years or older, admitted for a severe bacterial infection requiring at least 2 weeks of antibiotics, an SUD diagnosis (confirmed by chart review) and consultation by infectious diseases (IDs) and addiction medicine between July 2015 and March 2020 [beginning of Coronavirus Disease 2019 (COVID-19) stay at home measures in Oregon]. A descriptive study was performed to evaluate screening for co-infections during admission including HCV, HIV, syphilis, chlamydia, and gonorrhea, followed by a case–control analysis to determine patient-level factors associated with lack of any screening during their initial admission in the study time-period. We also described completion of additional HCV diagnostic testing with HCV viral load needed to confirm chronic HCV infection and eligibility for HCV treatment. We performed chart review to collect variables of interest, including demographics, housing status, type of insurance, details on their primary infection, admitting team, HCV, and HIV status prior to admission, and access to a primary-care provider. All ID consult notes were reviewed to determine which screening tests were recommended by the consulting ID team. SUD characteristics including type of substances used at time of hospital encounter, number of substances used, route of use (injection, inhalation, or ingestion), most recent use, and associated tobacco use was largely identified from the addiction medicine service initial consult note, which also detailed the patient’s Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) severity score for each substance used. Subsequent addiction medicine notes were used to determine SUD treatment initiation such as buprenorphine or methadone while inpatient. We reviewed the hospital discharge summary to capture referral for management of chronic infections such as HCV, and referral for PrEP. Laboratory tests and results performed during admission were collected from the electronic medical record via SAP BusinessObjects Enterprise Business Intelligence Platform 4.2 (SAP America, Inc., PA, USA).

We used SAS version 9.4 (SAS Institute Inc., Cary, NC, USA) to perform a descriptive analysis of patient characteristics, completed and recommended screening tests, in addition to positive test results. We compared categorical variables in univariable fashion by the chi-square or Fisher’s exact tests. We calculated crude and adjusted odds ratios (ORs) and 95% confidence intervals (CI) of cases (at least one screening test performed) with each exposure variable compared to the proportion of controls (no screening tests performed) with the exposure variable for the first admission during our study time-period. We used the Student’s \( t \)-test to
evaluate continuous variables. For multivariable analysis, we performed a stepwise logistic regression analysis with all variables with a p value of .2 or less considered for inclusion. Our final multivariable model included variables with a p value <.05, or if their addition significantly altered the OR of another variable present in the model.

This study was reviewed and approved by the Oregon Health & Science University Institutional Review Board (IRB00003522). This study was conducted under an approved Waiver of Health Insurance Portability and Accountability Act Authorization Requirement.

Results
We identified 280 patients with 320 eligible admissions for severe bacterial infection requiring at least 2 weeks of antibiotics, an SUD, and consultation by ID and addiction medicine between July 2015 and March 2020. Most patients were male (181, 64.6%) and Caucasian (260, 92.9%) with a median age of 38.5 years (range: 19–74 years) and unstable housing (161, 57.5%; Table 1). Opioids (215, 76.8%) followed by methamphetamines (194, 69.3%) were the most common substances used with 199 (71.0%) reporting use of >1 substance. Only 67 (23.9%) patients had a PCP who they had seen at least twice over the preceding 24 months. All but two patients had health insurance. Approximately half (134, 47.9%) of our cohort completed their antibiotic course in an inpatient facility. Over half (144, 51.4%) of patients had an unplanned emergency department visit or admission within 90 days of hospital discharge, and 7 (2.5%) patients died within 90 days of their initial admission.

Screening
Eleven patients (3.9%) had a diagnosis of HIV and 108 (38.7%) had chronic HCV confirmed by two positive HCV viral load tests at least 6 months apart, two of whom had been treated for HCV with ongoing positive viral load or reinfection. Eighty-nine percent (n = 250) of our cohort were screened for one or more co-infections during their first admission with only one patient never screened despite subsequent admissions. Of those screened, the greatest proportion was for HIV (219, 81.4% of those without history of HIV), HCV (94, 79.7% of those without a prior positive HCV antibody), syphilis (206, 73.6%), gonorrhea and chlamydia at any body site (47, 16.8%) with new positive tests identified in 60 (21.4%) people. Screening for all five co-infections was only completed in 15 (14.0%) of the 107 patients who had screening indications. There was not a statistically significant trend in proportion screened over time.

HIV
Screening for HIV was completed in 81.4% (n = 219) of patients with 145 (66.2%) done prior to ID consultation. Of those not screened (n = 50), 11 (22%) patients had recent HIV screening and 22 (44%) patients did not have HIV screening recommendations documented by the ID consult team. Screening was also not completed in 17 of 86 (19.7%) patients where ID providers recommended HIV screening. PrEP was documented as being discussed with only 5 (1.9%) patients prior to discharge with the ID team leading most of these (n = 4). Only one patient was prescribed HIV PrEP at discharge, two declined PrEP and two were referred for PrEP initiation in the outpatient setting.

HCV
Of the 118 patients without a prior HCV antibody test on admission, screening was completed in 94 (79.7%) and the primary team ordered tests in 47 (39.8%) prior to ID consultation. HCV antibody testing was not done in 24 (20.3%). The ID team recommended HCV antibody testing in all but 13 (11.0%) of those not screened. In those who were screened, 26 (22.0%) had a positive HCV antibody test with HCV viral load positive in 24 (20.3%). Of the 162 patients with confirmed chronic HCV or prior positive HCV antibody test, HCV antibody test was repeated in 78 (48.1%). Sixty-one percent of patients had indications for additional HCV diagnostic testing (viral load) of which 79.7% (n = 135) were completed during their admission.

Of the 54 patients with prior positive HCV antibody testing but without confirmation of chronic HCV or those previously treated for HCV and cured, three (5.6%) had a chronic HCV diagnosis confirmed during their admission, 8 (14.8%) with previous negative HCV viral load tests had a positive HCV viral load, 4 (7.4%) without a prior HCV viral load had a positive HCV viral load and 11 (20.3%) did not have additional viral load testing to confirm their HCV status.
Of those with confirmed chronic HCV prior to or during their admission, only 37 (34.6%) were referred for HCV treatment or follow-up, with most (29, 27.1%) instructed to follow-up with their PCP, of which only 6 (20.7%) had a PCP, while 8 (7.5%) had a referral placed to gastroenterology/hepatology at the time of discharge. Of the 70 without referral for HCV treatment, unplanned discharges were the most common reason documented (n = 19, 27%) with ongoing substance use documented in 3 (4.3%). Most (n = 44, 62.9%) did not have a reason documented for lack of referral for HCV treatment.

**Syphilis**

Syphilis screening was completed in 206 (73.6%) patients with 132 (46.9%) tests performed prior to ID consultation. ID recommended screening for an additional 85 patients (30.2%) of which only 14 (16.5%) were not completed. Sixty patients (21.4%) did not have recommendations made for syphilis screening, only 10 (16.7%) of which had syphilis testing within the last 12 months. Seven (3.4%) positive RPR tests were identified in the 206 patients screened. Three of these were...
diagnosed with neurosyphilis, and one with early latent syphilis, with three of the tests determined to be false positives or serofast status by the consulting ID provider. Of the three patients diagnosed with neurosyphilis, two were identified by screening alone while admitted for an unrelated bacterial infection. The third was admitted for a condition thought to be due to a gram-positive bacterial infection with the etiology later determined to be syphilis following ID recommended testing. All were treated during their hospital admission.

**Chlamydia and gonorrhea**

Only 47 (16.8%) patients in our cohort were screened for gonorrhea and chlamydia at any body site, of which 30 (63.8%) were done prior to ID consultation. A higher proportion of women (28.9%) were screened for gonorrhea and chlamydia compared to men (10.4%). Screening was recommended by ID for an additional 20 (8.6%) patients, and was not completed in 5 (25.0%) of these patients. No ID recommendations for screening were provided in 221 (94.8%) of those not screened with an additional 7 (3.0%) having recent screening performed prior to admission. One case of gonorrhea was identified by screening and treated during hospital admission.

**Case–control analysis**

In univariable analysis, older age (p = .01), lack of methamphetamine use (p < .01), reported alcohol use (.02), cirrhosis (.03), stable housing (p < .01), insurance other than Medicaid (p < .01), use of only one substance (p < .01), no reported injection drug use (p < .01), no documented screening recommendations by ID (p < .01), and having a PCP (p < .01) were statistically significantly associated with lack of any co-infection screening during the first admission in our study time-frame (Table 2). Other comorbidities, duration of hospitalization, admitting service, or site of their primary infection were not associated with a lack of screening. In multivariable analysis, non-Medicaid insurance (OR 2.8, 95% CI: 1.2–6.6, p = .02), use of only 1 substance (OR 2.9, 95% CI: 1.3–6.5, p < 0.01), and no documented screening recommendations by ID (OR 3.7, 95% CI: 1.5–8.8, p < .01), were statistically significantly associated with lack of screening for co-infection during hospital admission.

**Discussion**

Limited published data are available evaluating screening for co-infections in patients with SUD during inpatient admission.22 We describe missed opportunities to screen for co-infections in 20–80% of patients with SUD admitted for a serious bacterial infection, despite multiple guidelines recommending repeated screening in this population. 15,16,24–27 Screening for all five co-infections was completed in only a few patients who had screening indications. Even when ID consultation recommended screening tests, approximately 20% were not performed, and a majority of patients not screened did not have screening recommendations documented by ID, which was the strongest association with lack of screening. We did not identify a trend in proportion screened over time. In our study, use of only one substance, non-Medicaid insurance and lack of screening recommendations by the ID team were all more common in those with lack of co-infection screening. Additional factors identified as significant in univariable analysis (lack of methamphetamine use, stable housing, PCP, etc.) suggest that provider teams potentially perceived lower risks for co-infections in these groups. However, of those not screened, half had evidence of exposure to HCV and nearly three-quarters had used a substance within 7 days of their admission suggesting ongoing risk in this population not being screened. Overall, a high proportion of those screened had a new positive test during their admission, including three cases of neurosyphilis, highlighting the importance of regular screening and initiation of inpatient treatment to prevent community spread. Oregon has had recent increases in congenital syphilis and rates of positive STI tests during the COVID-19 pandemic and we expect to see more positive tests in the future, highlighting a need to increase screening in this population.5,28 Moreover, though PrEP, in combination with harm reduction interventions, is proven to be effective in decreasing transmission of HIV in patients who inject drugs, in our cohort, we found documentation of discussion of PrEP with few patients.29 Similarly, very few of those eligible received a referral for HCV treatment. Current guidelines recommend offering treatment to all patients with chronic HCV and no contraindications exist for ongoing active substance use.16 Recent advances in direct-acting antiviral medications for HCV treatment has meant simpler dosing regimens, fewer adverse effects, and higher treatment success, allowing more treatment management by PCPs compared.
to prior decades, which required specialist care. In addition, providing therapy to patients with SUD is a cost-effective strategy for reducing HCV burden.30 Inpatient HCV treatment is currently being piloted at OHSU; however, success of the program is tightly linked to our ability to adequately screen our population. Therefore, screening and then initiating HCV therapy during the inpatient admission or establishing structured referral processes to an outpatient provider for treatment are crucial to ensuring access to care and reduction of transmission in the community.

Chlamydia and gonorrhea screening was performed infrequently in our population, especially among men, and was substantially lower than the proportion screened for syphilis. Given the limited bandwidth for detailed contact tracing by public health departments for these infections, less data are available on the burden of disease in those with SUD compared to HIV, HCV, and syphilis.4,6,7,12,13 Since the primary mode of transmission in these diseases is sexual, the stark contrast in testing proportions between syphilis, HIV, chlamydia, and gonorrhea, may indicate a cognitive dissonance and an important role for bundled testing or creating order-sets for screening. In addition, ID providers did not consistently recommend testing for chlamydia and gonorrhea, indicating a need for additional education on SUD and associated behaviors that put patients at risk. Studies have shown those with SUD engage in more sex without condoms, transactional sex and sex with partners who inject drugs.8,9,31 In a large national cross-sectional data set between 2011 and 2015, Brookmeyer et al.6 identified both men and women who inject drugs to be more likely to have sex with a partner who also injects drugs, engage in transactional sex, and report two or more sexual partners in the last year compared to those who do not inject drugs. In addition, chlamydia or gonorrhea diagnoses in the last year, previous syphilis and herpes diagnoses were also more common in men and women who inject drugs compared to those who do not.6

In addition, over half of our population experienced unstable housing and less than a quarter had a PCP, reflecting significant structural, social and economic barriers to accessing healthcare, including screening and preventive care. A survey performed among people who use drugs in Ottawa between March and December 2013 reported unstable housing in a similar proportion (60.6%) with younger age, not having a PCP, monthly income less than $499, incarceration in the last 12 months, no support from peer workers

Table 2. Case–control analysis: factors associated with not being screened for any co-infection.

|                                      | Not screened | Screened | Univariable odds ratio (95% confidence interval) | Multivariable odds ratio (95% confidence interval) |
|--------------------------------------|--------------|----------|-------------------------------------------------|---------------------------------------------------|
|                                      | N (%)        | N (%)    |                                                 |                                                   |
| Age > 40 years                       | 21 (70.0%)   | 112 (44.8%) | 2.9 (1.3–6.5) | –                                                   |
| No methamphetamine use              | 16 (53.3%)   | 70 (28.0%) | 2.6 (1.3–6.3) | –                                                   |
| Alcohol use                          | 11 (36.7%)   | 46 (18.4%) | 2.3 (1.1–4.5) | –                                                   |
| No injection drug use                | 13 (43.3%)   | 41 (16.4%) | 3.8 (1.7–8.6) | –                                                   |
| Cirrhosis                            | 6 (20.0%)    | 20 (8.0%)  | 2.9 (1.1–7.9) | –                                                   |
| Housed                               | 20 (66.7%)   | 99 (39.6%) | 3.1 (1.4–6.8) | –                                                   |
| Primary-care provider                | 13 (43.3%)   | 54 (21.6%) | 2.8 (1.3–6.1) | –                                                   |
| Insurance other than Medicaid        | 12 (40%)     | 41 (16.4%) | 2.9 (1.5–5.6) | 2.8 (1.2–6.6)                                       |
| Use of only one substance            | 15 (50%)     | 59 (23.6%) | 3.2 (1.5–7.0) | 2.9 (1.3–6.5)                                       |
| No screening recommendations documented by ID | 11 (36.7%) | 20 (8.0%)  | 6.7 (2.8–15.9) | 3.7 (1.5–8.8)                                       |

ID, infectious diseases.
and non-public disability support payments as the primary income source associated with unstable housing. Another large population-based study in the US identified a significant increase in unstable housing among youth who inject drugs, with increased risky injection behaviors and transactional sex among those with unstable housing. In addition, unstable housing among Medicaid recipients was associated with increased chronic disease burden, increased frequency of hospitalization, emergency room use and overall expenditures 3.8 times higher than housed Medicaid recipients. The significant barriers related to unstable housing negatively impact both access to care and risk for co-infections, making hospital admission an even more important opportunity to provide additional screening, preventive health services, and treatment.

Our study has limitations. We describe our experience at a single academic medical center where the majority of our population is white, significantly limiting generalizability and our ability to identify and describe disparities resulting from structural racism. Our study population included those admitted with a severe bacterial infection requiring two or more weeks of antibiotics, who had both ID and addiction medicine consultations, which is a specific and small proportion of patients admitted with SUD. We suspect this group has a higher rate of co-infection screening compared to people with SUD who are not seen by ID and/or addiction medicine, as prevention and screening are often not the focus for inpatient providers while managing other acute illnesses. Due to the limited number of patients with certain exposures, we did not have adequate power to include all potential confounders in multivariable analysis. In addition, since our study is retrospective in nature, our data are restricted to what was documented in the chart, and it is possible that screening recommendations were made over the phone or PrEP was discussed with a patient but not documented. We expect this misclassification to be non-differential with regards to case–control status and would result in an underestimation of these variables in our population.

Our study has important implications for patient care, provider education, and future research. With limited funding to STI clinics and the impact of the COVID-19 pandemic on public health resources, hospital admissions can serve as an ideal moment and place to screen high-risk populations and initiate or refer for PrEP or HCV treatment. A shift in the mentality of inpatient care needs to occur to include these screening and preventive measures, as only focusing on the acute issue results in a failure to provide holistic care to our community. Given our population had both addiction medicine and ID team consultations, this group, theoretically, should have the optimal screening recommendations during their admission, yet we still identified multiple missed opportunities.

Providing medications for opioid use disorder to patients with SUD while in the hospital is a reachable moment. Similarly, screening for common co-infections while in the hospital and when access to care may otherwise be limited is critical. Screening and preventive services for disease can no longer be deferred to PCPs when many of the structural barriers associated with unstable housing have resulted in few patients with SUD having durable access to a PCP or any outpatient care in the setting of traditional public health systems being underfunded and overwhelmed. Efforts to improve inpatient provider education and awareness of stigma, structural determinants of health, addiction medicine and risks associated with co-infection acquisition should be implemented. With greater awareness and standardization of screening with bundles or order-sets, which have been recently implemented at our institution, we hope to normalize inpatient screening for co-infections. Normalization of screening then allows for appropriate treatment and education with less stigma and judgment. Furthermore, building effective processes and structure to allow these patients access to PrEP and HCV treatment in the inpatient setting with reliable transition to the outpatient setting is critical to reducing spread of these infections and lessening the public health burden. Future research should broaden the scope of patients studied to include any inpatient with SUD, evaluate provider biases and dynamics driving lack of screening recommendations, and assess implementation of PrEP reminders, screening order-sets, and referral pathways.

Our current screening for co-infections in patients with SUD during hospital admission is inadequate. Increased awareness can hopefully lead to more patients receiving treatment and prevention for co-infections and by doing so, lower the community spread and burden of multiple infections as an outcome of a hospitalization for a single one.
Declarations

**Ethics approval and consent to participate**
This study was reviewed and approved by the Oregon Health & Science University Institutional Review Board (IRB00003522). This study was conducted under an approved Waiver of Health Insurance Portability and Accountability Act Authorization Requirement.

**Consent for publication**
Not applicable.

**Author contributions**

**Cara D. Varley:** Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Supervision; Validation; Visualization; Writing – original draft; Writing – review & editing.

**Michael Conte:** Data curation; Methodology; Writing – original draft; Writing – review & editing.

**Amber C. Streifel:** Conceptualization; Data curation; Investigation; Methodology; Supervision; Writing – original draft; Writing – review & editing.

**Bradie Winders:** Data curation; Formal analysis; Writing – review & editing.

**Monica K. Sikka:** Conceptualization; Investigation; Methodology; Resources; Supervision; Writing – review & editing.

**Acknowledgements**
We would like to thank Luke Strnad, MD for his thoughtful review of the manuscript prior to publication and Brent Schneider, MD for his help with data collection.

**Funding**
The authors received no financial support for the research, authorship, and/or publication of this article.

**Competing interests**
The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

**Availability of data and materials**
None.

**ORCID iDs**

Cara D. Varley [https://orcid.org/0000-0003-3209-4489](https://orcid.org/0000-0003-3209-4489)

Monica K. Sikka [https://orcid.org/0000-0001-8192-8019](https://orcid.org/0000-0001-8192-8019)

**References**

1. Capizzi J, Leahy J, Wheelock H, et al. Population-based trends in hospitalizations due to injection drug use-related serious bacterial infections, Oregon, 2008 to 2018. *PLoS ONE* 2020; 15: e0242165.
2. Coyle JR, Freeland M, Eckel ST, et al. Trends in morbidity, mortality, and cost of hospitalizations associated with infectious disease sequelae of the opioid epidemic. *J Infect Dis* 2020; 222: S451–S457.
3. McCarthy NL, Bagg J, See I, et al. Bacterial infections associated with substance use disorders, large cohort of United States hospitals, 2012–2017. *Clin Infect Dis* 2020; 71: e37–e44.
4. Feaster DJ, Parish CL, Gooden L, et al. Substance use and STI acquisition: secondary analysis from the AWARE study. *Drug Alcohol Depend* 2016; 169: 171–179.
5. Oregon Health Authority. Increasing congenital syphilis in Oregon, 2021, https://www.oregon.gov/oha/PH/DISEASESCONDITIONS/HIVSTD/VIRALHEPATITIS/SEXUALLYTRANSMITTEDDISEASE/Documents/Increasing_Congenital_Syphilis_in_Oregon.pdf
6. Brookmeyer KA, Haderxhanaj LT, Hogben M, et al. Sexual risk behaviors and STDs among persons who inject drugs: a national study. *Prev Med* 2019; 126: 105779.
7. Reno H, Fox B, Highfill C, et al. The emerging intersection between injection drug use and early syphilis in nonurban areas of Missouri, 2012–2018. *J Infect Dis* 2020; 222: S465–S470.
8. Cavanaugh CE, Floyd LJ, Penniman TV, et al. Examining racial/ethnic disparities in sexually transmitted diseases among recent heroin-using and cocaine-using women. *J Womens Health* 2011; 20: 197–205.
9. Clingan SE, Fisher DG, Hardan-Khalil K, et al. Health implications of sex trading characteristics in Long Beach, California, USA. *Int J STD AIDS* 2019; 30: 647–655.
10. Peters PJ, Pontones P, Hoover KW, et al. HIV infection linked to injection use of oxymorphone in Indiana 2014–2015. *N Engl J Med* 2016; 375: 229–239.
11. Centers for Disease Control Prevention. National overview sexually transmitted disease surveillance 2019, https://www.cdc.gov/std/statistics/2019/overview.htm#anchor_1606829809494 (2021, accessed 22 February 2022).

12. Multnomah County Health Department. HIV increases in 2019 among people who use drugs, https://www.multco.us/multnomah-county/news/health-officials-alert-public-increase-hiv-infections-among-people-who-use (2019, accessed 22 February 2022).

13. Capizzi J, Leahy J, Skrypkar D, et al. HIV and Hepatitis C diagnoses among injection drug use related hospitalizations in Oregon, 2008–2018, https://opha.memberclicks.net/assets/HIV%20and%20Hepatitis%20C%20diagnoses%20among%20injection%20drug%20use%20related%20hospitalizations%20in%20Oregon.pdf (2020, 22 February 2022).

14. Maness DL, Riley E and Studebaker G. Hepatitis C: diagnosis and management. Am Fam Physician 2021; 104: 626–635.

15. Schillie S, Wester C, Osborne M, et al. CDC recommendations for hepatitis C screening among adults – United States, 2020. MMWR Recomm Rep 2020; 69: 1–17.

16. AASLD-IDSA HCV Guidance Panel. Hepatitis C guidance 2018 update: AASLD-IDSA recommendations for testing, managing, and treating hepatitis C virus infection. Clin Infect Dis 2018; 67: 1477–1492.

17. Bhatel M, Lin WC, Zhang J, et al. Health care utilization patterns of homeless individuals in Boston: preparing for Medicaid expansion under the affordable care act. Am J Public Health 2013; 103(Suppl. 2): S311–S317.

18. Hotton AL, Mackesy-Ammit ME and Boordram B. Trends in homelessness and injection practices among young urban and suburban people who inject drugs: 1997-2017. Medrxiv [Preprint] 2021. DOI: 10.1101/2021.02.26.21252551.

19. Khondor E, Mason K, Chambers C, et al. Access to primary health care among homeless adults in Toronto, Canada: results from the street health survey. Open Med 2011; 5: e94–e103.

20. Rowlands Snyder EC, Boucher LM, Bayoumi AM, et al. A cross-sectional study of factors associated with unstable housing among marginalized people who use drugs in Ottawa, Canada. PLoS ONE 2021; 16: e0253923.

21. Zivanovic R, Milloy MJ, Hayashi K, et al. Impact of unstable housing on all-cause mortality among persons who inject drugs. BMC Public Health 2015; 15: 106.

22. Marks LR, Reno H, Liang SY, et al. Value of packaged testing for sexually transmitted infections for persons who inject drugs hospitalized with serious injection-related infections. Open Forum Infect Dis 2021; 8: ofab489.

23. American Psychiatric Publishing. Diagnostic and statistical manual of mental disorders. 5th ed. Washington, DC: American Psychiatric Publishing, 2013.

24. LeFevre ML. Screening for chlamydia and gonorrhea: U.S. preventive services task force recommendation statement. Ann Intern Med 2014; 161: 902–910.

25. Workowski KA and Bolan GA. Sexually transmitted diseases treatment guidelines, 2015. MMWR Recomm Rep 2015; 64: 1–137.

26. Owens DK, Davidson KW, Krist AH, et al. Screening for HIV infection: US preventive services task force recommendation statement. JAMA 2019; 321: 2326–2336.

27. Bibbins-Domingo K, Grossman DC, Curry SJ, et al. Screening for syphilis infection in nonpregnant adults and adolescents: US preventive services task force recommendation statement. JAMA 2016; 315: 2321–2327.

28. Menza TW, Zlot AI, Garai J, et al. The impact of the SARS-CoV-2 pandemic on human immunodeficiency virus and bacterial sexually transmitted infection testing and diagnosis in Oregon. Sex Transm Dis 2021; 48: e59–e63.

29. Choopanya K, Martin M, Suntharasamai P, et al. Antiretroviral prophylaxis for HIV infection in injecting drug users in Bangkok, Thailand (the Bangkok Tenofovir Study): a randomised, double-blind, placebo-controlled phase 3 trial. Lancet 2013; 381: 2083–2090.

30. Barbosa C, Fraser H, Hoerger TJ, et al. Cost-effectiveness of scaling-up HCV prevention and treatment in the United States for people who inject drugs. Addiction 2019; 114: 2267–2278.

31. Scott-Sheldon LA, Carey MP, Vanable PA, et al. Alcohol consumption, drug use, and condom use among STD clinic patients. J Stud Alcohol Drugs 2009; 70: 762–770.

32. Englander H, Dobbertin K, Lind BK, et al. Inpatient addiction medicine consultation and post-hospital substance use disorder treatment engagement: a propensity-matched analysis. J Gen Intern Med 2019; 34: 2796–2803.