

Value of Packaged Testing for Sexually Transmitted Infections for Persons who Inject Drugs Hospitalized With Serious Injection-Related Infections

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Background. Persons who inject drugs (PWID) are frequently admitted for serious injection-related infections (SIRIs). PWID are also at risk for sexually transmitted infections (STIs).

Methods. We conducted a multicenter quality improvement project at 3 hospitals in Missouri. PWID with SIRI who received an infectious diseases consultation were prospectively identified and placed into an electronic database as part of a Centers for Disease Control and Prevention–funded quality improvement project. Baseline data were collected from 8/1/2019 to 1/30/2020. During the intervention period (2/1/2020–2/28/2021), infectious diseases physicians caring for patients received 2 interventions: (1) email reminders of best practice screening for HIV, viral hepatitis, and STIs; (2) access to a customized EPIC SmartPhrase that included checkboxes of orders to include in assessment and plan of consultation notes. STI screening rates were compared before and after the intervention. We then calculated odds ratios to evaluate for risk factors for STIs in the cohort.

Results. Three hundred ninety-four unique patients were included in the cohort. Initial screening rates were highest for hepatitis C (88%), followed by HIV (86%). The bundled intervention improved screening rates for all conditions and substantially improved screening rates for gonorrhea, chlamydia, and syphilis (30% vs 51%, 30% vs 51%, and 39 vs 60%, respectively; $P < .001$). Of patients who underwent screening, 16.9% were positive for at least 1 STI. In general, demographics were not strongly associated with STIs.

Conclusions. PWID admitted for SIRI frequently have unrecognized STIs. Our bundled intervention improved STI screening rates, but additional interventions are needed to optimize screening.

Keywords. substance abuse; opioid use disorder; sexually transmitted infections; viral hepatitis.

Globally, estimates suggest that >15.6 million persons engage in injection drug use (IDU) [1]. The devastating consequences of this epidemic are not limited to the ongoing overdose crisis and include multiple converging infectious disease epidemics [2–4]. Bacterial infections are currently among the most common medical complications and reasons for hospitalization in persons who inject drugs (PWID) [5, 6]. The most feared infectious complications of IDU include serious injection-related infections (SIRIs) such as complicated skin and soft tissue infections, osteomyelitis, epidural abscesses, septic arthritis, and endocarditis.

Hospitalizations for SIRI have been identified as an ideal opportunity to engage patients in substance use disorder treatment and may constitute a reachable moment for a population with often limited access to primary care [7, 8]. Thus, hospitalizations for SIRI may represent an opportunity for PWID to receive recommended screening and preventative care practices including testing for viral hepatitis, HIV, and other sexually transmitted infections, as well as immunization for hepatitis A and B and linkage to pre-exposure prophylaxis (PrEP) for HIV [9, 10].

An emerging body of evidence has identified injection drug use (IDU) as an important risk factor for sexually transmitted infections (STIs) [11–13]. PWID engage in sexual behaviors that may place them at increased risk of acquiring sexually transmitted infections, including participation in survival sex, with resultant higher rates of STIs [14, 15]. Yet, routine STI screening remains uncommon among PWID. A recent study in Pittsburgh found that only 3 in 10 men and 5 in 10 women who used injection drugs reported getting an STI test within the last year [16]. The true incidence of STIs among PWID hospitalized with SIRI is unknown.

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The purpose of this manuscript is to describe the baseline prevalence of STIs among PWID who are admitted with SIRI and describe the impact of an educational intervention for consultants on STI screening rates.

METHODS

Setting

This quality improvement initiative occurred at 3 hospitals that participated in local quality improvement initiatives and a Centers for Disease Control and Prevention (CDC) Developing Healthcare Safety Research Contract between 8/1/2019 and 2/28/2021. Sites included Barnes-Jewish Hospital (BJH), a 1400-bed academic tertiary center in St. Louis, Missouri; Parkland Health Center, a 49-bed rural community hospital in Farmington, Missouri; and Missouri Baptist Sullivan Hospital, a 35-bed rural community hospital in Sullivan, Missouri.

Cohort Selection

Patients were required to be admitted to 1 of the above hospitals for an SIRI during the study period and have received an infectious diseases consultation. Consultations were performed in-person at the tertiary center in St. Louis, and patients at rural community hospitals received telehealth consultations from a Washington University Infectious Diseases physician. SIRIs were defined as endocarditis, epidural abscess, septic arthritis, *Staphylococcus aureus* bacteremia, and osteomyelitis. All SIRIs were required to be secondary to IDU as determined by the consulting infectious diseases physician. The pre-implementation period was defined as 8/1/2019–1/30/2020; the intervention period was defined as 2/1/2020–2/28/2021. These dates were selected as part of a CDC-funded quality improvement project.

Intervention

A standardized set of recommendations for screening patients with invasive bacterial and fungal infections secondary to IDU was implemented at all 3 sites. Infectious diseases consultants were asked to use a standardized checklist to encourage packaged STI and viral hepatitis testing on all PWID admitted with invasive infections. A smart link, known as a “dot-phrase” in the EPIC electronic medical record, was created for infectious diseases fellows and consultants to document screening

recommendations for patients with SIRIs at the time of consultation (Supplementary Figure 1). A dot-phrase is a section of text intended to be inserted quickly into the body of an electronic medical record note and contains prepopulated default text with customizable areas that require completion before the note may be signed. The development of the “dot-phrase” standardized practice and documentation. Consultants were reminded to use the dot-phrase and received email notifications of recommended core screening tests and immunizations on a monthly basis throughout the duration of the intervention period. Standardized screenings recommended by this intervention are listed in Table 1. Consultants were encouraged to refer patients to postdischarge PrEP visits through the Washington University Infectious Diseases clinic, where patients were offered either telemedicine or in-person follow-up for PrEP care and uninsured patient visits could be subsidized with grant funds. This work was part of a local quality improvement initiative and a CDC Developing Healthcare Safety Research Contract.

Data Collection

For patients who had multiple admissions for SIRIs, the first hospital admission during this period was included in the analysis. Patient demographics and substance use characteristics were reviewed in the electronic medical record and recorded in a database. Patients’ counties of residence were classified according to the 2013 US Department of Agriculture (USDA) Rural-Urban Continuum Codes (RUCCs) [17]. The RUCCs designate a code for each county based on a 9-level urban–rural continuum scale, using population thresholds and proximity to a metropolitan statistical area. The USDA RUCC codes are grouped into a metro or urban category (codes 1–3) and nonmetro (or rural) category (codes 4–9). Of those that were identified to have STIs, chart review was also performed to evaluate for the presence or absence of documented symptoms during their SIRI hospital admission. Hepatitis B immunization records were limited to records of the health care system studied as well as the Illinois comprehensive automated immunization registry exchange, which is integrated with the electronic medical record. Data on referral to PrEP after discharge and retention in PrEP care were obtained from chart review and were limited to hospital systems using the EPIC electronic medical record.

Table 1. Screening Recommendations for PWID Admitted With Serious Injection-Related Infections

| | Screening Tests |
|-------------------------|---|
| HIV | HIV ½ Ab + P24 Ag at initial visit [32, 9]; screen every 3 months if ongoing substance use. |
| Hepatitis B virus | HBV surface Ag at each visit. Evaluate immunity at initial visit with HBV surface antibody and core antibody. Immunize if nonimmune. Link patients with active HBV to infectious diseases care [32, 9]. |
| Hepatitis C virus | HCV Ab at initial visit. If positive, obtain HCV RNA and link to HCV treatment for viremic patients [32, 9]. |
| Syphilis | RPR should be assessed at initial visit. Additional testing as indicated by sexual health history [9]. |
| Gonorrhea and chlamydia | Gonorrhea and chlamydia nucleic acid amplification testing (urine) at initial visit. Additional pharyngeal or rectal testing as indicated by sexual health history [33, 9]. |

Abbreviations: Ab, antibody; HBV, hepatitis B virus; HCV, hepatitis C virus; RPR, rapid plasma reagin.

Statistical Analysis

Demographic and clinical characteristics between the pre- and postimplementation periods were compared for all patients by group using the Mann-Whitney *U* test for continuous variables of age and the Fisher exact test for all other categorical variables. Crude prevalence and unadjusted odds ratios with 95% CIs for STI positivity were calculated for individual variables (Table 3). All analyses were performed using IBM SPSS software, version 27.0 (IBM Statistics, Armonk, NY, USA). Statistical significance was set at $P < .05$. This study was approved and granted a waiver of consent by the Washington University Institutional Review Board (IRB# 201907187 and 201908015).

RESULTS

Demographics

A total of 394 unique patients were seen by infectious diseases consultants for SIRI between 7/1/2019 and 2/1/2021. Patient characteristics and types of infections were not significantly different between the pre- and postimplementation

periods (Table 2). Patient substance use patterns were notable for a gradual replacement of heroin with fentanyl during the postimplementation period, while concurrent methamphetamine use remained stable during both time periods. Testing for all STIs and viral hepatitis increased during the postimplementation period, with statistically significant increases seen for gonorrhea, chlamydia, and syphilis ($P < .001$), which had the lowest testing rates pre-implementation. Testing for hepatitis C and HIV had the highest adherence rates.

STI Testing Results

STIs were common among PWID in our cohort (Table 3). In total, 37 unique patients (16.9%) were positive for at least 1 STI during an admission for an SIRI, with several testing positive for multiple concurrent infections. Testing remained lower among men (49.7% received testing) compared with women (63.7%; $P = .006$). Chart review of patients with positive STI testing identified documented symptoms in only 8 of the 37 individuals who were found to have either gonorrhea, chlamydia,

Table 2. Demographics of PWID Admitted for Serious Injection-Related Infections

| | Pre-Implementation (n = 123) | Postimplementation (n = 271) | PValue |
|--|---------------------------------|---------------------------------|--------|
| Demographics | | | |
| Age, mean ± SD, y | 41 ± 10.1 | 40 ± 10.2 | .404 |
| Male | 79 (64.2) | 158 (58.3) | .264 |
| White | 78 (63.4) | 175 (64.6) | .824 |
| Unhoused | 45 (36.6) | 117 (43.2) | .216 |
| Rural county | 18 (14.6) | 52 (19.2) | .266 |
| Substance use history^a | | | |
| Heroin | 83 (67.5) | 119 (43.9) | <.001 |
| Fentanyl | 64 (52.0) | 219 (80.8) | <.001 |
| Methamphetamine | 48 (39.0) | 105 (38.7) | .958 |
| Cocaine | 37 (30.1) | 87 (32.1) | .688 |
| Benzodiazepine | 15 (12.2) | 47 (17.3) | .185 |
| Testing performed | | | |
| Hepatitis B | 100 (81.3) | 227 (83.7) | .549 |
| Hepatitis C | 108 (87.8) | 252 (92.9) | .098 |
| HIV | 106 (86.2) | 249 (91.9) | .173 |
| Gonorrhea | 37 (30.1) | 139 (51.3) | .001 |
| Chlamydia | 37 (30.1) | 139 (51.3) | <.001 |
| Syphilis | 48 (39.0) | 163 (60.2) | <.001 |
| Immunizations & HIV PrEP | | | |
| HAV immunization administered | 10 (8.1) | 22 (8.1) | .100 |
| HBV immunization administered | 10 (8.1) | 23 (8.4) | .958 |
| Referred for HIV PrEP | 8 (6.5) | 54 (19.9) | <.001 |
| Reason for admission^b | | | |
| Infective endocarditis | 29 (23.6) | 81 (29.9) | .191 |
| Osteoarticular infection | 41 (33.3) | 89 (32.8) | .923 |
| Complicated skin and soft tissue infection | 40 (32.5) | 73 (26.9) | .259 |
| Other bacteremia | 25 (20.3) | 42 (15.5) | .243 |

Data are presented as No. (%) unless otherwise indicated.

Abbreviations: HAV, hepatitis A virus; HBV, hepatitis B virus; PrEP, pre-exposure prophylaxis; PWID, persons who inject drugs.

^aPatients may report more than 1 type of substance use.

^bPatients may present with multiple concurrent serious injection-related infections.

Table 3. Characteristics of PWID Testing Positive for Sexually Transmitted Infections

| | Gonorrhea Odds Ratio (95% CI) | Chlamydia Odds Ratio (95% CI) | Syphilis Odds Ratio (95% CI) | Gonorrhea, Chlamydia, Syphilis Odds Ratio (95% CI) |
|--------------------------------------|----------------------------------|----------------------------------|---------------------------------|---|
| No. positive/No. tested (% positive) | 10/176 (5.7) | 11/176 (6.3) | 21/211 (10.0) | 37/218 (16.9) |
| Age <40 y | 1.96 (0.50–7.67) | 1.96 (0.50–7.67) | 1.21 (0.47–3.05) | 1.57 (0.75–3.30) |
| Male | 0.19 (0.04–0.95) | 0.69 (0.20–2.36) | 0.72 (0.29–1.78) | 0.53 (0.26–1.09) |
| White | 1.04 (0.28–3.82) | 0.56 (0.16–1.89) | 0.34 (0.14–0.85) | 0.37 (0.18–0.75) |
| Unhoused | 0.47 (0.12–1.88) | 1.41 (0.41–4.78) | 2.81 (1.08–7.28) | 1.97 (0.96–4.00) |
| Rural county | 4.15 (1.08–15.8) | 0.53 (0.06–4.35) | 0.42 (0.09–1.89) | 0.96 (0.39–2.35) |
| Heroin use | 1.36 (0.37–5.00) | 1.61 (0.45–5.70) | 0.96 (0.39–2.38) | 1.03 (0.51–2.08) |
| Fentanyl use | 0.71 (0.18–2.85) | 0.71 (0.18–2.85) | 1.11 (0.22–5.45) | 0.69 (0.31–1.55) |
| Methamphetamine use | 1.59 (0.44–5.72) | 0.56 (0.14–2.19) | 0.44 (0.15–1.25) | 0.73 (0.35–1.55) |

Abbreviation: PWID, persons who inject drugs.

or syphilis at the time of admission for SIRI. All patients received treatment for their STIs during their inpatient admissions. Sexually transmitted infections including gonorrhea, chlamydia, and syphilis were common across all ages and were not limited to younger PWID. Black race was associated with increased risk of any STI, unhoused status was associated with an increased risk of syphilis, and rural residence was associated with an increased risk of gonorrhea (Table 3).

HIV and viral hepatitis were also common among this population; 90.1% of patients admitted for SIRI were tested for HIV, with 23 (6.5%) of PWID identified as HIV-positive, including 4 new HIV diagnoses. Of the 19 PWID with known HIV, only 6 were currently engaged in care and had viral loads of <500 on admission. All PWID were re-linked to HIV care during their admissions. Given the current recommendation by the CDC that all PWID are eligible for HIV PrEP and Missouri's classification as an area at risk for an HIV outbreak, infectious diseases consultants were encouraged to refer PWID for PrEP postdischarge [18, 19]. While the rate of PrEP referral was noted to increase after discharge ($P < .001$), only a minority (6/62) of the patients referred for PrEP were documented as retained on PrEP at 3 months postdischarge.

Active hepatitis B (positive HBV surface antigen and positive HBV DNA) was identified in 8.2% of PWID tested for hepatitis

B, and another 8.5% had resolved hepatitis B (immunity from natural infection; positive HBV surface antibody and positive anti-HBc, negative HBsAg). Among PWID with active hepatitis B infection, viral loads were high, with a mean viral load of 5.2 logs. Active hepatitis B infection was associated with older age ($P < .001$), likely related to introduction of the hepatitis B vaccine into the childhood immunization schedule. None of the PWID with active hepatitis B infection were engaged in HBV treatment at the time of admission. Overall rates of hepatitis B immunity were low in this population, with only 101 patients (25.6% of the total cohort) having either a positive hepatitis B surface antibody or documented prior immunization against hepatitis B. Congruent with this finding, 179 patients (49.4%) admitted for SIRI were nonimmune to hepatitis B with either negative surface antibodies or no documented prior immunization (Table 4). Uptake of HBV immunizations did not significantly increase during the project period despite inclusion of this practice as part of standardized recommendations provided by infectious diseases consultants ($P = .958$).

DISCUSSION

To our knowledge, this is the first study to both (1) describe baseline STI screening rates among hospitalized PWID and (2) evaluate the impact of a quality improvement intervention

Table 4. PWID Serologic Characteristics for Hepatitis B Virus

| | Active Hepatitis B (n = 27), No. (%) | Resolved Hepatitis B (n = 28), No. (%) | Hepatitis B Immune (n = 101), No. (%) | Hepatitis B Nonimmune (n = 179), No. (%) | Hepatitis B Immunization Provided if Nonimmune (n = 33), No. (%) |
|---------------------|---|---|--|---|--|
| Age <40 y | 5 (18.5) | 13 (46.4) | 72 (71.3) | 94 (52.5) | 18 (54.5) |
| Male | 22 (81.5) | 15 (53.6) | 51 (50.5) | 104 (58.1) | 18 (54.5) |
| White | 20 (74.1) | 17 (60.7) | 63 (62.4) | 106 (59.2) | 24 (72.7) |
| Unhoused | 15 (55.6) | 14 (50.0) | 37 (36.6) | 79 (44.1) | 18 (54.5) |
| Rural county | 5 (18.5) | 4 (14.3) | 16 (15.8) | 34 (19.0) | 9 (27.3) |
| Heroin use | 13 (48.1) | 12 (42.9) | 52 (51.1) | 94 (52.5) | 22 (66.7) |
| Fentanyl use | 17 (63.0) | 24 (85.7) | 73 (72.3) | 128 (71.5) | 30 (90.9) |
| Methamphetamine use | 7 (25.9) | 6 (21.4) | 41 (40.6) | 67 (37.4) | 20 (60.6) |

Abbreviation: PWID, persons who inject drugs.

to improve STI screening practices. We found high rates of STI infections both at baseline and during the study period. Furthermore, an educational reminder coupled with development of an electronic medical record smart phrase improved STI screening rates during the study period. These results support using a systematic approach to screen and treat PWID who present to the hospital. Our use of an electronic medical record dot-phrase to increase adherence to recommended core screening guidelines was simple, inexpensive, and benefited patients and the health care system by increasing detection of communicable diseases within an at-risk population. This intervention was implemented at both an academic center and 2 rural community hospitals and is scalable at other hospitals with electronic medical records.

Hospitalization for an IDU-related infection is a key health care opportunity for PWID. Many PWID may not have regular access to preventative health care [20–23] where such screening would normally occur. Implementing screening among hospitalized PWID is a feasible initial approach, as the screening tests, results, and treatment options can all be discussed during a single hospitalization. This reduces the likelihood of loss to follow-up, which may occur when patients receive only episodic care in the emergency department or other ambulatory care settings.

Our findings support a universal STI screening approach among PWID. Sexually transmitted infections were common across all ages and were not limited to younger PWID. Similarly, while being unhoused was identified as a significant risk factor for syphilis, other STIs could not be accurately predicted based solely on patient characteristics and risk factors. The majority of PWID did not have STI symptoms, suggesting that a symptom-based approach would miss a substantial percentage of STI cases. This is not surprising, as prior studies focused on targeted screening of undifferentiated symptomatic and asymptomatic emergency department patients have identified chlamydia and gonorrhea rates in the young adult age group ranging from 4% to 14% [24–28].

Both sexual exposure and injection drug use represent major risk factors for HBV infection in the United States [29]. PWID can be a challenging population to reach for primary preventative health care, and survey data from 2013 indicate that only one-third of adults have completed the 3-dose HBV vaccination series, with this number estimated to be even lower in PWID [30]. The low rate of hepatitis B immunity observed in this study reinforces these findings and is particularly concerning in the context of a high prevalence of active hepatitis B. These results highlight the urgent need to incorporate hepatitis B virus vaccination into education and harm reduction services for PWID. Prior research has demonstrated that convenience and immediate availability are key to hepatitis A and B vaccination uptake among PWID [31]. The inpatient hospitalization for an infectious complication of injection

drug use should represent an ideal touchpoint to provide viral hepatitis screening paired with immediate availability of HAV and HBV immunizations. However, despite a standardized approach to recommending HAV and HBV immunizations for nonimmune PWID, immunizations for hepatitis B did not increase following the intervention. This is likely multifactorial, as many patients had immunizations ordered but not administered, either due to patient-directed discharge prior to when immunizations were scheduled to be administered (most were scheduled to be given on discharge) or related to patient refusal. The multiple competing priorities for providing care for PWID with SIRI ranging from surgical interventions to medical management of complex comorbidities may also contribute to the low rate of immunization uptake and PrEP referral by providers. Further research regarding strategies to improve immunization in hospitalized PWID should focus on system barriers to administration, provider education, and vaccine hesitancy in this population.

Despite implementing a successful low-cost intervention to improve STI screening and immunizations among PWID, our team believes that substantial work is still required for several reasons. First, screening for gonorrhea, chlamydia, and syphilis remained low, even after our intervention. Second, despite relatively high screening rates for hepatitis C and HIV, our team believes that any patient not screened for HIV represents a substantial missed opportunity. Programs supporting expansion of point-of-care HIV testing for PWID, particularly in the emergency department, remain crucial. Third, immunization rates did not significantly improve during the intervention period. Proactive and multidisciplinary interventions are likely required to further improve our immunization rates. Clinical decision support to remind clinicians to screen PWID for HIV and other STIs, as well as supporting standardized administration of HAV and HBV immunizations to hospitalized PWID, requires further exploration.

Limitations to our findings are that results may not be generalizable to other institutions. Missouri has high rates of STIs when compared nationally. This study was limited to PWID who were admitted for SIRI and received an infectious diseases consult. Additionally, this study did not assess other risk factors for STI acquisition among PWID with SIRI, including number of sex partners, symptoms, and participation in sex work or survival sex. It is likely that some PWID with STIs had symptoms that were not documented in the medical chart. Finally, our study focused on PWID who were admitted with an SIRI; it is possible that the STI rates in this population may not reflect those of all PWID.

In conclusion, our data demonstrate that STIs are common among PWID admitted with SIRIs. Implementation of electronic tools can help improve screening for gonorrhea, chlamydia, trichomonas, syphilis, HIV, HBV, and HCV, and administration of vaccinations for hepatitis A and B if indicated.

However, additional research is required to further improve screening rates to acceptable levels.

Supplementary Data

Supplementary materials are available at *Open Forum Infectious Diseases* online. Consisting of data provided by the authors to benefit the reader, the posted materials are not copyedited and are the sole responsibility of the authors, so questions or comments should be addressed to the corresponding author.

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Patient consent. This study was approved and granted a waiver of consent by the Washington University Institutional Review Board before any research activities were performed.

Author contributions. L.M., S.L., and M.D. conceptualized and designed the study and had full access to all data in the study. They take responsibility for the integrity of the data and the accuracy of the data analysis. All authors contributed to the writing and critical revision of the report. All authors contributed to the data acquisition, data analysis, or data interpretation and reviewed and approved the final version.

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