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A Collaborative Intervention Between Emergency Medicine and Infectious Diseases to Increase Syphilis and HIV Screening in the Emergency Department

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Background: Sexually transmitted infections (STIs) are a common reason for evaluation in the emergency department (ED). Given the overlapping risk factors for STIs, patients screened for gonorrhea and chlamydia should be tested for syphilis and HIV. Syphilis and HIV testing rates in the ED have been reported to be low. The study objective was to examine whether collaboration between emergency medicine (EM) and infectious disease (ID) providers improved syphilis and HIV testing in the ED.

Methods: A multidisciplinary team of EM and ID providers was formed to identify and address barriers to syphilis and HIV testing in the ED. Syphilis, HIV, chlamydia, and gonorrhea testing and infection rates were calculated and compared during 2 time periods: preintervention (January 1, 2012–December 30, 2017) and postintervention (November 1, 2018–November 30, 2019). We also extracted clinical and laboratory data from patients with positive syphilis and HIV results during the study period.

Results: The most commonly cited barrier to syphilis and HIV testing was concern about follow-up of positive results. Compared with the preintervention period, syphilis and HIV testing rates increased significantly in the postintervention period (incidence rate ratios, 30.70 [$P < 0.0001$] and 28.99 [$P < 0.0001$] for syphilis and HIV, respectively). The postintervention period was also associated with a significant increase in the identification of patients with positive syphilis and HIV results (incidence rate ratios, 7.02 [$P < 0.0001$] and 2.34 [$P = 0.03$], respectively).

Conclusions: Collaboration between EM and ID providers resulted in a significant increase in syphilis and HIV testing and diagnosis in the ED.

Syphilis and HIV continue to be major public health threats in the United States.[1,2] Although the annual incidence of HIV has decreased significantly since the beginning of the HIV epidemic, rates of new HIV infections have remained roughly stable over the past decade, with 37,881 new HIV infections reported in the United States in 2018.[1] Unfortunately, HIV infection often goes undiagnosed, with an estimated 1 of every 7 people living with HIV unaware of their diagnosis. This finding has significant public health implications as those who are unaware of their diagnosis may account for up to one-third of all new HIV transmissions in the United States.[3] Early diagnosis of HIV and treatment with antiretroviral therapy (ART) has been shown to reduce complications and improve overall morbidity and mortality of the individual.[4] In addition, people living with HIV who have sustained viral suppression on ART are effectively unable to transmit the virus to others, so early diagnosis and linkage to care can also have a profound impact on HIV prevention in the community.[5]

In the case of syphilis, there has been an increased number of reported syphilis cases over the past decade in the United States, with an estimated 115,045 number of reported cases in 2018 including 1306 cases of congenital syphilis.[2] Over the past several years, Columbus, Ohio, has been experiencing a significant syphilis outbreak. Between 2013 and 2017, there was a 109% increase in local syphilis rates, with local rates 2 times higher than overall US rates.[6] In addition to the known sequelae of syphilis (which can include severe cardiovascular or neurologic complications), studies have shown a link between a diagnosis of syphilis and future risk of HIV infection.[7]

Emergency departments (EDs) are often the only point of health care access for many individuals at risk for sexually transmitted infections (STIs). Emergency department visits for STI exposures or STI-related complaints are very common.[8] Although most patients who request STI testing or who present with STI-related complaints in the ED are screened for chlamydia and gonorrhea, rates of HIV and syphilis testing are low.[9] In the case of HIV, previously reported barriers to testing in the ED include perceived lack of time, unfamiliarity with screening guidelines, provider discomfort in addressing positive results, concerns about adequate follow-up, and misperceptions regarding a specific individual's risks.[10–12] For syphilis, a commonly cited barrier to testing in the ED include concerns about patient follow-up.[13] Given the importance of early diagnosis and treatment of syphilis and HIV, interventions focused on decreasing barriers to testing are needed.

A multidisciplinary team of emergency medicine (EM) and infectious disease (ID) providers was formed to identify and address barriers to syphilis and HIV testing in the ED. The primary objective of this study was to measure rates of testing and diagnosis for syphilis and HIV in a community-based ED associated with a large academic medical center before and after the implementation of a multifaceted and collaborative intervention. The ED is located in an urban area in Columbus, Ohio, that serves a large minority

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population with high rates of poverty and limited access to health care (approximately 50% of patients covered by Medicaid). It is located in direct proximity to 4 of the zip codes with the highest rates of syphilis in the county and in 1 of the 48 counties identified by the US Department of Health and Human Services as a region of high HIV incidence as part of the "Ending the HIV Epidemic" initiative.[14,15]

MATERIALS AND METHODS

After the formation of the multidisciplinary team of EM and ID providers, an anonymous survey was distributed to EM providers in order to identify barriers to syphilis and HIV testing in the ED during the first phase of the intervention. Educational materials, which included a review of the most recent Centers for Diseases Control and Prevention sexually transmitted disease treatment guidelines were provided as a resource for EM providers.[16] The second phase involved the generation of automated daily reports with the results of all syphilis and HIV tests performed in the ED. The reports were reviewed on daily basis by an ID provider from the study team to ensure appropriate management and follow-up for patients with positive results. In cases where patients with positive results could not be reached or located, the ID providers communicated and sought assistance from disease intervention specialists at the local health department. In addition, one ID provider from the team was assigned to be "on-call" on a rotating basis to help answer questions about STI testing and follow-up. Finally, a dedicated STI "order set" was created in the electronic medical record to facilitate the process of ordering STI-related tests, including syphilis and HIV, and medications.

Thirteen months after the multidisciplinary team was created and the aforementioned interventions were implemented, we collected the total number of syphilis, HIV, chlamydia, and gonorrhea tests and results that were performed for any reason at the Ohio State University Wexner Medical Center (OSUWMC) Hospital East ED during the preintervention (January 1, 2012–December 31, 2017) and postintervention (November 1, 2018–November 30, 2019) periods. The number of tests performed and the corresponding results were collected from the Information Warehouse at the OSUWMC. Demographic, clinical, and laboratory data were then extracted from the electronic medical record of patients who tested positive for syphilis and HIV during the preintervention and postintervention periods. Fourth-generation HIV-1/HIV-2 antigen-antibody (Ag/Ab) assay was used as an initial screening test, with positive results confirmed with an HIV-1/HIV-2 differentiation immunoassay and HIV-1 nucleic acid testing in accordance with Centers for Diseases Control and Prevention recommendations. For syphilis, a reverse sequence screening algorithm was used and positive syphilis antibody immunoassay results were confirmed with rapid plasma reagin (RPR) and *Treponema pallidum* particle agglutination (TP-PA) assay if the RPR was nonreactive.

Incidence rate ratios (IRRs) were calculated by comparing the rate of events (both rates of testing and rates of positive results) per unit of time, normalized against days during the preintervention and postintervention periods. χ^2 Tests were used for dichotomous comparisons as appropriate. All analyses were conducted in STATA 16.0. Two tailed P values were considered statistically significant.

The study was approved by the institutional review board of the Ohio State University.

RESULTS

Seventy-five EM providers completed the survey addressing barriers to syphilis and HIV testing in the ED. Most survey responders felt that the ED was either a "very appropriate" or "somewhat appropriate" setting for syphilis screening (60/75; 80.0%) and HIV screening (53/75; 70.7%). However, when asked about barriers to screening for syphilis and HIV in the ED, the 2 most commonly cited reasons were "I do not want to follow-up on testing" (41/111; 36.9%) and "I do not want the liability to be on me if there are no available resources" (32/111; 28.8%). When EM providers were asked whether they would be willing to order syphilis and HIV testing for patients who require chlamydia and gonorrhea testing if a team of ID providers helped with patient notification and linkage to care, 72 (96%) of 75 reported that they would be "willing" or "very willing" to order testing.

The results of preintervention and postintervention syphilis, HIV, chlamydia, and gonorrhea testing in the ED are shown in Figure 1. Compared with the preintervention period, there was no significant difference between rates of chlamydia or gonorrhea testing during the postintervention period (328 tests/month vs. 329 tests/month: IRR, 0.97; 95% confidence interval [CI], 0.93–1.01; $P = 0.141$). The postintervention period was associated with an increased likelihood of a positive gonorrhea test result (IRR, 1.32; 95% CI, 1.13–1.54; $P < 0.001$), but not a positive chlamydia test result (IRR, 0.99; 95% CI, 0.89–1.10; $P = 0.81$). There was also an increase in extragenital testing of chlamydia and gonorrhea during the postintervention period (160 oral tests and 32 rectal tests) compared with the preintervention period in which there was almost no extragenital testing for gonorrhea or chlamydia performed.

Compared with the preintervention period, the postintervention period was associated with an increased rate of syphilis testing (4 tests/month vs. 108 tests/month: IRR, 30.70; 95% CI, 26.8–35.2; $P < 0.0001$). It was also associated with an increased identification of individuals with a positive syphilis test result (0.63 tests/month vs. 4.4 tests/month: IRR, 7.02; 95% CI, 4.66–10.61; $P < 0.0001$) and an increase in the number of people who were treated for syphilis (0.49 people/month vs. 1.1 people/month: IRR, 2.22; 95% CI, 1.10–4.22; $P = 0.02$). Three (5.3%) of 57 patients with positive syphilis antibody test results were identified as having primary or secondary syphilis. All 3 patients received appropriate treatment. Twenty-six (46%) of 57 patients with positive syphilis antibody test results were identified as having late latent syphilis. Six (23.1%) of the 26 patients with late latent syphilis completed a full course of treatment, 5 (19.2%) of the 26 patients with late latent syphilis completed partial treatment, and 15 (57.7%) of the 26 patients with late latent syphilis did not receive any treatment because they were lost to follow-up. Twenty-eight patients had syphilis results that were consistent with a known previously treated infection, and 8 additional patients were considered to have false-positive screening results (defined as having a reactive syphilis antibody but nonreactive RPR and TP-PA). Table 1 shows the characteristics of patients diagnosed with syphilis during the postintervention period. Of the 57 patients in the postintervention period with positive syphilis test results, 50 were HIV negative and 23 of those had an outpatient referral placed for HIV preexposure prophylaxis (PrEP).

Compared with the preintervention period, the postintervention period was associated with an increase in the rate of HIV testing (4 tests/month vs. 125 tests/month: IRR, 28.99; 95% CI, 25.73–32.67; $P < 0.0001$). The intervention was also associated with an increased frequency of positive HIV test results (0.36 tests/month vs. 0.85 tests/month: IR 2.34; 95% CI, 1.4–4.91; $P = 0.03$). Of the 11 positive HIV test results documented during the postintervention period, 7 were from patients who had a new diagnosis. The remaining 4 positive HIV test results were from patients who had a previous diagnosis, although 2 of them were not in care and were not taking any ART. Follow-up of the 2 patients who were out of care was not available. All new HIV diagnoses were in men with a median age of 32 years (range, 27–56 years). Five of the 7 patients with new HIV diagnosis were rapidly linked

to care and started on ART (mean time to evaluation by an ID provider was 5.4 days; range, 1–15 days). Table 2 shows the characteristics of patients with newly diagnosed HIV infection who were identified during the postintervention time period.

DISCUSSION

The ED plays an important role in STI testing and treatment. Although patients who are screened for STIs in the ED are routinely tested for chlamydia and gonorrhea, the same does not hold true for syphilis and HIV despite the overlapping risk factors for infection.[16] Failure to test for syphilis and HIV in the ED is a missed opportunity that can contribute to delay in diagnosis, treatment, and/or linkage to medical care and has public health implications.[17,18]

Before our intervention, syphilis and HIV testing in the OSUWMC Hospital East ED was remarkably low (Fig. 1). Survey results demonstrated that the major barrier to testing was concerns regarding follow-up of positive results and linkage to care. The inherent algorithmic complexity of available syphilis and HIV tests can also be problematic in an acute and fast-paced setting such as the ED. For example, although we use a rapid fourth-generation HIV-1/HIV-2 Ag/Ab assay as the initial screening test, confirmatory testing (e.g., HIV-1/HIV-2 antibody differentiation and HIV-1 RNA polymerase chain reaction) can take several days to result. In the case of syphilis testing, particularly with reverse sequence screening that uses an initial syphilis antibody, there is often a 2- to 4-day turnaround time for the reflex RPR or TP-PA to result, and even then these can be challenging to interpret by the EM providers who may not be familiar with the algorithms or if prior testing and treatment records are not readily available for review. The usual OSUWMC Hospital East ED protocol for relaying pending STI results to patients (such as for chlamydia and gonorrhea) is via a letter sent by mail, as many patients may have already received empiric treatment during their visit. However, because of the more sensitive and complex

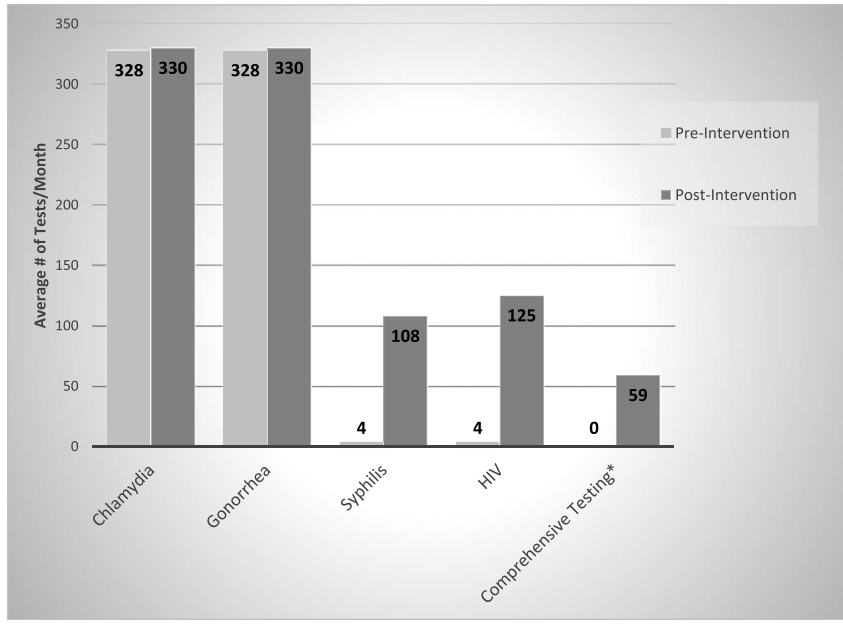
TABLE 1. Characteristics of Patients Diagnosed With Syphilis (Postintervention)*

Age, y	Sex	Race	RPR Titer	Diagnosis	Received Treatment?
34	F	White	1:2	Late latent	Yes
34	M	Black	1:64	Secondary	Yes
32	F	Black	1:128	Late latent	Partial†
37	F	Black	1:16	Secondary	Yes
54	M	Black	NR‡	Late latent	Partial
28	M	Black	1:256	Late latent	Partial
31	M	Black	1:1	Late latent	Partial
27	M	Black	1:128	Late latent	Yes
30	F	Black	1:256	Primary	Yes
45	F	Black	1:128	Late latent	Partial
18	M	Black	NR	Late latent	Yes
39	F	Black	1:1	Late latent	Yes
46	M	Black	1:8	Late latent	Yes
53	F	Black	1:2	Late latent	Yes
33	F	Black	NR	Late latent	No
24	M	Black	1:64	Late latent	No
43	M	Other	1:4	Late latent	No
53	F	Black	NR	Late latent	No
25	M	Black	NR	Late latent	No
56	M	Black	NR	Late latent	No
31	F	White	1:16	Late latent	No
41	F	Black	NR	Late latent	No
25	M	Black	1:32	Late latent	No
30	M	White	1:2	Late latent	No
57	M	Black	NR	Late latent	No
41	M	Black	NR	Late latent	No
58	F	Black	NR	Late latent	No
51	F	Black	NR	Late latent	No
41	M	Black	NR	Late latent	No

*All patients included in the table had reactive syphilis antibody immunoassay results.

†Denotes that patient received at least some treatment of syphilis.

‡NR denotes a nonreactive RPR. All patients with NR RPR had reactive *Treponema pallidum* particle agglutination assays.



*Chlamydia, Gonorrhea, Syphilis, and HIV testing all performed on the same ED visit.

Figure 1. Rates of STI Screening in the Emergency Department During the Preintervention Period (January 1 2012–December 31, 2017) and Postintervention Period (November 1 2018–November 30, 2019). *Chlamydia, gonorrhea, syphilis, and HIV testing all performed on the same ED visit.

TABLE 2. Characteristics of Patients With Newly Diagnosed HIV Infection (Postintervention)

Patient No.	Presenting Complaint/Diagnosis	CD4 Count at Diagnosis, cells/mm^3	Days Until ID Evaluation	Started on ART?	Other STIs at Diagnosis	Prior STI Diagnosis
1	Lymphadenopathy	762	4	Yes	No	No
2	PJP	90	1	Yes	No	No
3	Urethritis	156	6	Yes	No	Chlamydia
4	Urethritis	155	15	Yes	Syphilis, gonorrhea, chlamydia	Chlamydia, gonorrhea
5	Urethritis	320	1	Yes	Gonorrhea	No
6	Urethritis	N/A	N/A	No	No	No
7	Urethritis	N/A	N/A	No	Syphilis, gonorrhea	No

N/A indicates not applicable; PJP, *Pneumocystis jirovecii* pneumonia.

nature of a new HIV diagnosis, direct verbal communication with the patient is preferable so that any questions or concerns can be answered.[11] This could create logistical difficulties for EM providers, as they often work variable hours and may not feel comfortable answering specific questions regarding management and follow-up. In addition, the ability to provide prompt linkage to care is also a concern. Standard referrals placed for an ID clinic appointment may take several weeks to schedule, and prior studies have shown that longer wait times for appointments increase the risk that the patient will be lost to follow-up.[19]

Despite significant improvements in the number of people who were screened for HIV and syphilis during the postintervention period, there are still a substantial proportion of people who are still only being screened for gonorrhea or chlamydia without also being screened for HIV and syphilis. Further investigation into ongoing barriers is needed, particularly to assess whether the discrepancies can be accounted for by variations in individual clinician's practices or whether there may be patient-specific barriers (such as an unwillingness to undergo venipuncture). The current use of the "STI order set" is optional, and clinicians are able to order individual STI tests without using the order set. One proposed solution would be to create an alternative type of order panel in which the ordering of any one STI test would automatically pull in the orders for the other tests and would require clinicians to manually opt out of orders for comprehensive testing depending on individual circumstances.

Of the 7 new HIV diagnoses identified in the ED during the postintervention period, successful linkage to care and initiation of ART was achieved in most of these patients within 1 to 15 days (median, 6 days) of their ED visit. These findings underscore the fact that involvement of ID providers in the follow-up of patients with positive test results, particularly for HIV, can be advantageous. However, despite the relatively short interval follow-up that was provided to patients with positive HIV test results, there are data suggesting that initiating ART on the day of diagnosis leads to improved outcomes, including increased retention in care and higher rates of viral suppression.[20] Further interventions, such as the utilization of telemedicine consults or access to same day ID clinic appointments, designed to promote same-day ART initiation should be evaluated.

Despite an increase in the number of patients who were treated for syphilis during the postintervention period, overall follow-up was suboptimal. Treatment for patients with primary and secondary syphilis was very effective, primarily because most of these patients had symptoms that led to a clinical diagnosis and therefore received empiric treatment in the ED before discharge. For those patients who were diagnosed with late-latent syphilis, the rates of follow-up and treatment were lower. Several patients were unable to be reached despite assistance from the local health department disease intervention specialist. Other centers have successfully used point-of-care (POC) testing, where tests results were available before the patient being discharged. This strategy could potentially alleviate some of the difficulty with follow-up, particularly for asymptomatic patients.[21–23]

Of the HIV-negative patients with positive syphilis antibody test results during the postintervention period, less than half were referred for evaluation for PrEP. Because there is an association between syphilis infection and future risk of HIV acquisition, patients who test positive for syphilis infection are a high-priority group that should be referred for or offered HIV PrEP.[24] Data pertaining to the number of patients who were referred for PrEP who tested negative for syphilis (including those with a positive gonorrhea or chlamydia test result) were not available.

Rates of chlamydia and gonorrhea testing remained stable between the preintervention and postintervention time periods. The postintervention time period was associated with an increased likelihood of a positive gonorrhea test result, but not a positive chlamydia test result. These findings correlate with a general increased incidence of gonorrhea infection seen in the community during this time.[25] Although there was an increase in extragenital gonorrhea/chlamydia testing during the postintervention period, the rates continue to remain very low, with less than 5% of chlamydia or gonorrhea tests performed at any extragenital site. Promoting patient self-collection of pharyngeal and rectal swabs for gonorrhea/chlamydia testing in the ED may help increase extragenital testing rates.[26] Further work is needed to identify additional barriers and improve testing rates, as patients with oral and/or rectal infections may often have negative urine/cervical/urethral testing depending on sexual practices.[27]

Study limitations include the absence of clear follow-up data for patients with positive syphilis and HIV test results during the preintervention period. For this particular study, we did not evaluate the specific indications for STI screening, so we were unable to make an assessment on the overall adequacy of screening in the ED. However, we made the assumption that anyone with an indication for gonorrhea or chlamydia would have also had an indication for syphilis and HIV screening, which was the basis for our comparison. Another limitation to our study is that we do not know whether patients who tested positive for gonorrhea or chlamydia (but not syphilis) or those with negative gonorrhea and chlamydia test results, but engage in high-risk sexual practices, were referred for PrEP. Although education about PrEP was provided to all EM providers, and a system for rapid referral for initial PrEP visits at a Federally Qualified Health Center clinic located within the same hospital was put in place, referral rates and show rates were low overall. Further work will be needed to better gauge local PrEP uptake among individuals who present to the ED and are at risk for HIV acquisition. Best practices, including use of patient navigators, will be evaluated in the next phase of this project.

In addition, the reverse sequence screening and fourth-generation HIV-1/HIV-2 Ag/Ab testing platforms used at our institution for syphilis and HIV, respectively, are not POC tests. Therefore,

we do not know if the availability of POC syphilis and HIV tests would have resulted in a similar increase in testing regardless of our designed interventions. Finally, our study took place in an academic institution with a core group of ID providers who have an interest in syphilis and HIV; it is important to note that importantly effort related to this project was supported with funding from a competitive institutional grant program. Therefore, our findings may not be generalizable to institutions that do not have providers or institutional specific disease intervention specialists who can shoulder some or all of the aforementioned responsibilities.

In conclusion, findings from this study demonstrate that incorporating ID providers to facilitate timely follow-up of syphilis and HIV test results ordered by EM providers can result in a substantial increase in the number of patients who are tested, with increased case finding. Additional studies looking at how the collaboration between ID and EM providers can improve the management and follow-up of patients who are tested for syphilis and HIV in the ED are needed.

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