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MAJOR ARTICLE

Multidisciplinary Approach to Improve Human Immunodeficiency Virus and Syphilis Testing Rates in Emergency Departments

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Background. Best practice guidelines recommend that patients at risk for sexually transmitted infections (STIs), such as gonorrhea (GC) and chlamydia, should also be tested for human immunodeficiency virus (HIV) and syphilis. This prospective quality assurance study aimed to increase HIV and syphilis testing rates in emergency departments (EDs) across the Cleveland Clinic Health System from January 1, 2020 through January 1, 2022.

Methods. A multidisciplinary team of emergency medicine, infectious diseases, pharmacy, and microbiology personnel convened to identify barriers to HIV and syphilis testing during ED encounters at which GC/chlamydia were tested. The following interventions were implemented in response: rapid HIV testing with new a workflow for results follow-up, a standardized STI-screening order panel, and feedback to clinicians about ordering patterns.

Results. There were 57 797 ED visits with GC/chlamydia testing completed during the study period. Human immunodeficiency virus testing was ordered at 5% of these encounters before the interventions were implemented and increased to 8%, 23%, and 36% after each successive intervention. Syphilis testing increased from 9% before the interventions to 12%, 28%, and 39% after each successive intervention. In multivariable analyses adjusted for age, gender, and location, the odds ratio for HIV and syphilis testing after all interventions was 11.72 (95% confidence interval [CI], 10.82–12.71; $P \leq .001$) and 6.79 (95% CI, 6.34–7.27; $P \leq .001$), respectively.

Conclusions. The multidisciplinary intervention resulted in improved testing rates for HIV and syphilis.

Keywords. emergency medicine; human immunodeficiency virus; screening; sexually transmitted infections; syphilis.

Over the past decade, rates of human immunodeficiency virus (HIV) testing have increased, leading to new diagnoses and connection to care with primary HIV and infectious diseases (ID) clinicians [1]. Timely connection to care has enabled earlier initiation of antiretroviral therapy (ART) and improved outcomes, including lower acquired immune deficiency syndrome (AIDS)-related clinical events, better mortality outcomes, and decreased rates of transmission [2–5]. Of the 1.2 million people living with HIV, approximately 15% are unaware of their infection and account for approximately 40% of new HIV transmissions [6]. Rates of new syphilis diagnoses annually are even higher than HIV. In 2019, there were 3 times as many new syphilis diagnoses compared with HIV [7]. When undiagnosed, syphilis leads to congenital transmission, transmission among sexual partners, and tertiary complications.

The Centers for Disease Control and Prevention (CDC) and the United States Preventive Taskforce (UPSTF) recommend that individuals at risk for sexually transmitted infections (STIs) undergo screening for HIV and syphilis [7–10]. Under CDC guidelines, this entails at least annual testing for HIV in persons who have shared needles during injection drug use, have other sexually transmitted infections (STIs), or exchange sex for money [8]. The UPSTF also recommends more frequent testing in individuals with male-to-male sexual contact, injection drug use, sex without condom use, sex for drugs or money, positive testing for other STIs, a partner with an STI, or in patients who request STI testing [10].

Despite these recommendations, there are many missed opportunities for HIV testing in primary care, emergency care, as well as in the inpatient setting [11–18]. An internal review of missed opportunities at the Cleveland Clinic Health System (CCHS) revealed that 77% of patients newly diagnosed with HIV had at least 1 opportunity for testing in the emergency

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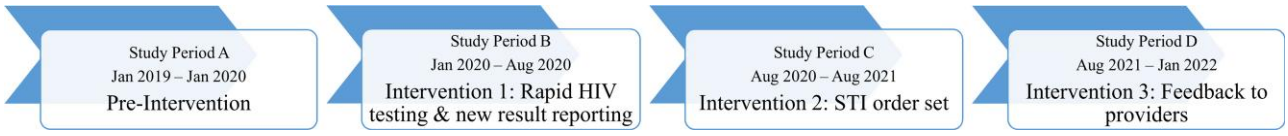

Figure 1. Timeline of interventions completed by Study Periods A, B, C, and D. HIV, human immunodeficiency virus; STI, sexually transmitted infection

department (ED) or primary care office in the 3 years before diagnosis, and 75% had no record of any prior HIV test. Due to late diagnoses, 35% presented with AIDS-defining illness at the time of diagnosis. Other studies have also demonstrated high rates of missed opportunities for HIV diagnosis and late presentations of HIV [11, 12, 14, 16, 17, 19]. A retrospective review at a quaternary care center by Liggett et al [11] noted that 56% of patients had no HIV testing before diagnosis and 31% presented with CD4 counts less than 200 cell/mm^3.

Syphilis similarly is an underdiagnosed and late-presenting disease [7]. The CDC reported significantly rising rates of syphilis, from 5973 primary and secondary cases in 2013 to 30 644 primary and secondary cases in 2017 [20]. In this time frame, rates of syphilis rose over 150% among women, with a subsequent rise in congenital cases diagnosed each year. Furthermore, syphilis has been declared a public health outbreak in the catchment area of the CCHS. In Cuyahoga County, where the main CCHS academic hospital is located, cases numbers rose by 56% between 2016 and 2020 [21].

The ED is an opportune environment in which to increase rates of HIV and syphilis testing. Patients who do not have an established primary care provider may present to the ED for STI treatment and testing [22]. Although national guidelines recommend that patients reporting high-risk exposures or need for STI testing also be tested for HIV and syphilis [7–10], a study by Klein et al [23] reported as few as 4% of patients tested for STIs were concurrently tested for HIV and syphilis in an academic ED, and a study querying the Nationwide Emergency Department Sample reported a 3.9% and 2.9% testing rate for HIV and syphilis, respectively, in patients presenting for STI encounters [24].

The aim of this study was to evaluate whether a multidisciplinary, multitiered intervention would increase rates of testing for HIV and syphilis in patients at risk for STIs who present to the ED. Patients at risk for STIs were identified as those undergoing screening for gonorrhea (GC) and/or chlamydia.

METHODS

This study was conducted within the CCHS in Ohio, which is a large, integrated health system comprised of a quaternary, urban medical center, suburban and urban community hospitals, as well as suburban and urban free-standing EDs. Only EDs in northeast Ohio were included in the analysis, and interventions were rolled out to all sites in northeast Ohio at the same time. All sites utilized EPIC (Verona, WI) as the electronic medical record (EMR). Emergency department clinicians included attending physicians, resident physicians, physician assistants, and nurse practitioners.

There were 13 clinical sites in this region with approximately 750 000 ED encounters annually. Sites with over 50 000 encounters annually, including the quaternary medical center and 3 community hospital EDs, were considered higher volume EDs. Lower volume EDs included community hospitals that saw approximately 30 000–40 000 encounters annually, and free-standing EDs had the lowest volume of encounters with approximately 20 000 encounters annually.

A multidisciplinary team of emergency medicine, pharmacy, microbiology, and ID personnel convened to identify barriers to HIV and syphilis testing in the ED. To address these barriers, several interventions were deployed (Figure 1).

Intervention 1: January 2020

Preliminary discussions were conducted with ED providers to gather information on barriers to testing. Emergency department clinicians reported concerns regarding increased ED encounter time if serum laboratory HIV and/or syphilis testing were ordered during encounters for STI testing. Sexually transmitted infection encounters consisted mainly of GC/chlamydia testing by genital swab or urinary test, which were perceived by clinicians to take less time compared with serum laboratory draws. An internal review found that median encounter time for visits with serum testing was only 7 minutes longer than visits without serum tests, a difference that was considered negligible.

Before this study, turnaround time for HIV testing did not result during the ED encounter, and clinicians were concerned about the ability to reach patients to convey test results. At that time, the microbiology laboratory utilized fourth-generation HIV-1 p24 Antigen/HIV-1/2 antibody assays that resulted in 1–3 days and reflexed to the HIV-1/HIV-2 antibody differentiation assay for confirmation, with an additional 1- to 3-day turnaround time. To improve turnaround time, OraQuick ADVANCE Rapid HIV-1/2 Antibody Assay (OraSure Technologies, Bethlehem, PA) was implemented at all ED testing sites on January 6, 2020. This test is a lateral flow antibody assay that can be read by laboratory personnel (or clinicians) after 15 minutes. Although the lateral flow antibody assay can be used as a point-of-care test within the ED, it is read by the

Microbiology Department so that positive testing will automatically reflex to fourth-generation testing. Turnaround time for rapid HIV testing subsequently decreased from 1–3 days to 2 hours. This test was already utilized for testing occupational exposures and was made available for ED use. Therefore additional laboratory personnel or funding were not required to implement this change. Emergency department clinicians counseled patients regarding their preliminary testing results during the ED encounter with minimal impact on ED throughput.

Laboratory processing for syphilis was 1–3 days and remained unchanged in the postintervention setting. The microbiology laboratory followed the reverse screening algorithm with a treponemal syphilis multiplex flow immunoassay for qualitative detection of total immunoglobulin (Ig) (Ig)G/IgM antibodies. If positive, this reflexed to semiquantitative nontreponemal rapid plasma reagin (RPR) testing. Testing for *Treponema pallidum* IgG testing was done by enzyme immunoassay if syphilis IgG was detected with a nonreactive RPR.

Emergency department practitioners also had concerns regarding the time required for pretest and posttest HIV counseling. Although positive GC/chlamydia and syphilis results were reviewed and intervened upon by ED pharmacists through an ED callback program to the satisfaction of ED clinicians [25], confirmatory positive HIV results were directed to the ordering ED clinician for review, which was not part of the standard workflow. Emergency department clinicians would not follow test results when off duty and had no mechanism to address these results outside of their ED time when triaging other priorities. This led to delays in callback to patients and dissatisfaction among providers when called at home to manage these results. In addition, the ED pharmacists did not feel comfortable providing posttest counseling for HIV test results, as they did with GC/chlamydia and syphilis.

To address these concerns, a new workflow and partnership with the department of infectious disease was established. In accordance with CDC recommendations for opt-out testing [26], ED clinicians informed patients of HIV testing and were provided with an information pamphlet on OraQuick ADVANCE rapid testing. In the event of a positive test result, ED clinicians counseled patients on the initial positive test result during their ED encounter. Preliminary positive rapid HIV tests reflexed to confirmatory laboratory testing and were routed to an infectious disease inbox in the EMR. The ID clinician followed the confirmatory test result and contacted patients for posttest counseling. These patients were offered follow-up appointments with the ID department for initiation of HIV care if confirmed positive or initiation of HIV pre-exposure prophylaxis (PrEP) if negative.

The operational updates were presented to ED directors for the urban, community, and free-standing EDs. The site-specific ED directors further disseminated these updates at department, monthly personnel meetings, and via email communication.

Intervention 2: August 2020

To further increase HIV and syphilis testing uptake, an STI-screening order panel was implemented on August 17, 2020 with GC/chlamydia, trichomoniasis, and HIV and syphilis testing all preselected in the panel as opt-out features. Whenever a clinician attempted to order one of these tests individually, using search criteria such as "gonorrhea" or "STD," the EMR would prioritize the STI order panel in the order screen. The order panel also included a link for a quick download of the HIV rapid test information pamphlet that was presented to patients at the time of ordering HIV testing. Emergency department clinicians were encouraged to use the order panel for all STI screening encounters.

Intervention 3: August 2021

The Emergency Medicine Enterprise Quality leadership coordinated education efforts. Information was first communicated to each site-specific ED Medical Director who then relayed this information at their departmental staff meetings. In addition, general education on the clinical significance of HIV and syphilis testing, reminders about the STI order panel, and data on increased testing at each site were also distributed to all ED clinicians by email. Finally, each director was provided with data on their clinicians' ordering behaviors and reviewed this information with clinicians in personal conversations. Enterprise leadership assisted as needed.

Data Collection and Analysis

Data were retrospectively obtained from the Cleveland Clinic Enterprise Data Vault for all emergency encounters at which GC/chlamydia was ordered over a 3-year period. The proportions of visits at which HIV testing and the proportion of visits at which syphilis testing was ordered were compared over 4 study periods: the preintervention period, January 1, 2019—January 6, 2020 (study period A), between intervention 1 and intervention 2, January 7, 2020—August 17, 2020 (study period B), between intervention 2 and intervention 3, August 18, 2020—August 3, 2021 (study period C), and over 4 months after all 3 interventions were implemented, August 4, 2021—January 1, 2022 (study period D).

An interrupted time series was performed to evaluate the rates of testing over time. Proportions of visits where HIV and syphilis were ordered were compared across study periods using the χ^2 test. The effect of the study period on the proportion tested was examined separately for HIV and syphilis testing in multivariable logistic regression analyses, adjusted for patient, age, gender, and ED location. Statistical analyses were done using R version 4.1.2 (R Foundation for Statistical Computing) [27].

Table 1. Demographics

Characteristics	Study Period A	Study Period B	Study Period C	Study Period D
Total GC/chlamydia	21 561	10 486	18 614	7136
Age	29.07 (±10.73 SD)	28.96 (±10.68 SD)	29.08 (±10.64)	29.97 (±11.22)
Sex				
Female	71.0% (15 310)	67.3% (7057)	67.1% (12 496)	66.7% (4757)
Male	29.0% (6250)	32.7% (3429)	32.9% (6118)	33.3% (2378)
Nonbinary	0% (1)	0% (0)	0% (0)	0% (1)
Race				
Black	64.7% (13 965)	66.5% (6973)	66.8% (12 439)	66.3% (4733)
White	24.2% (5208)	23.5% (2465)	23.0% (4274)	22.6% (1615)
Other	7.5% (1611)	7.0% (731)	7.5% (1399)	7.5% (253)
Unavailable	3.6% (777)	3.0% (317)	2.7% (502)	3.6% (253)

Abbreviations: GC, gonorrhea; SD, standard deviation.

Table 2. Proportion of HIV and Syphilis per GC/Chlamydia Tests Ordered

Encounters	Study Period A	Study Period B	Study Period C	Study Period D	Odds Ratio Postinterventions	*P* Value
Number of GC/chlamydia	21 561	10 486	18 614	7136		
HIV/GC/chlamydia	4.9% (1060)	7.6% (799)	23.2% (4332)	35.6% (2541)	12.71	$P \leq .001$
Syphilis/GC/chlamydia	9.3% (2012)	11.5% (1204)	27.5% (5118)	38.7% (2762)	6.79	$P \leq .001$

Abbreviations: GC, gonorrhea; HIV, human immunodeficiency virus.

Patient Consent Statement

The design of the work was approved for human subject research under the Cleveland Clinic Institutional Review Board.

RESULTS

Within the CCHS in Ohio, there were 57 797 ED visits at which GC/chlamydia testing was ordered during the 3-year study period. Patient age was distributed with a mean (standard deviation) of 29 (11) years (Table 1). The majority of patients were female (68.0%) and Black (66.1%). The proportions of visits where an HIV test was ordered were 5% in the preintervention period (A), 8% in period B, 23% in period C, and 36% in period D (Table 2). The proportions of visits at which syphilis testing was ordered were 9%, 12%, 28%, and 39%, respectively, for the 4 study periods.

In multivariable analyses, compared to the preintervention period, successive postintervention periods were associated with increasingly higher odds of having an HIV test ordered (Figure 2): study period B (odds ratio [OR], 1.61; 95% confidence interval [CI], 1.46–1.77; $P = 2.44$), study period C (OR, 6.29; 95% CI, 5.85–6.76; $P \leq .001$), and study period D (OR, 11.72; 95% CI, 10.82–12.71; $P \leq .001$). There were also increasingly higher odds of having a syphilis test ordered: study period B (OR, 1.25; 95% CI, 1.16–1.35; $P = 1.28$), study period C (OR, 3.97; 95% CI, 3.74–4.20; $P \leq .001$), and study period D (OR, 6.79; 95% CI, 6.34–7.27; $P \leq .001$) (Table 2).

The Cleveland Clinic ED sites were characterized by volume: higher volume hospital-based EDs, lower volume hospital-based EDs, or free-standing EDs (Figure 3). Free-standing and lower volume EDs initially had lower proportions of testing, but they surpassed rates of testing compared to higher volume EDs after the interventions.

During the study period, 30 patients were diagnosed with HIV, 21 of whom decided to establish care with the Cleveland Clinic ID practice and were initiated on ART. Of those patients who were positive but did not establish care with the Cleveland Clinic, all but 2 had confirmed follow-up with a local ID practice. The remaining 2 were unable to be reached despite multiple attempts and were subsequently referred to the Department of Health. All 3 patients who were initially antibody positive for rapid testing but negative on confirmatory testing were offered PrEP via telephone or an in-person encounter. There were 13 syphilis cases diagnosed in the 1-year preintervention period, January 1, 2019—January 6, 2020, and 124 syphilis cases diagnosed in the 2-year intervention period, January 7, 2020—January 1, 2022. These results were communicated to patients via the ED callback program. Patients were offered treatment in the ED or referred to their primary care physician, other established physician, or the Board of Health for treatment depending on patient preference.

DISCUSSION

The ED is a location where vulnerable populations and those with limited healthcare access may seek care for STIs [22]. However, there are barriers involved with posttest counseling for positive HIV test results, including competing priorities in the high-acuity environment of the ED, ability to reach the

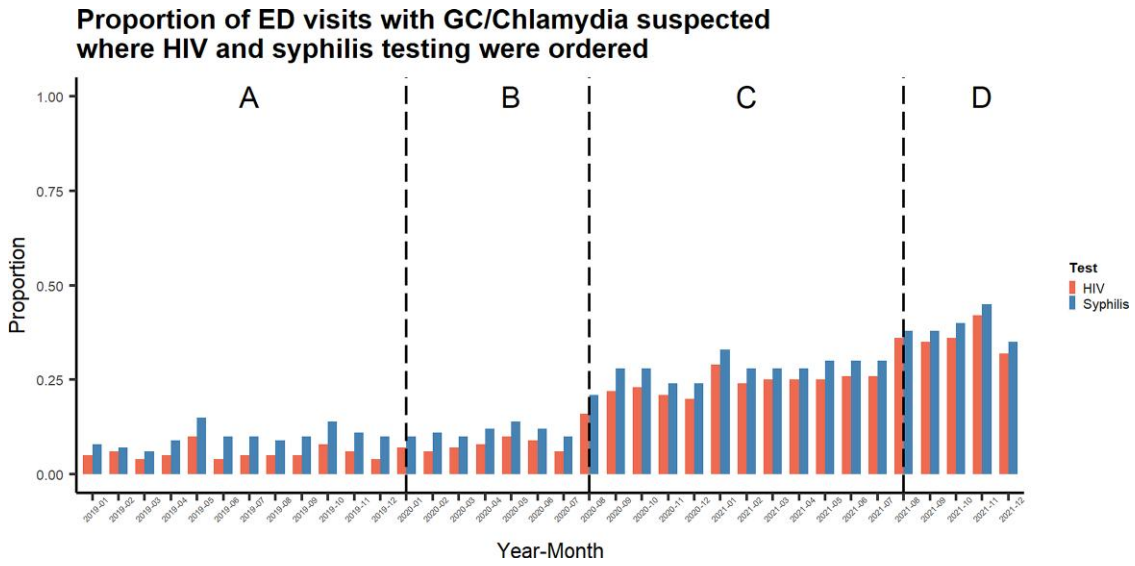

Figure 2. Proportion of human immunodeficiency virus (HIV) and syphilis testing ordered per emergency department (ED) encounters with gonorrhea/chlamydia ordered per study period: Study Period A January 2019—January 2020, preintervention; Study Period B January 2020—August 2020, after Intervention 1 with implementation of rapid HIV testing and new workflow for result reporting; Study Period C August 2020—August 2021, after Intervention 2 with implementation of the sexually transmitted infection (STI) order set; Study Period D August 2021—January 2022, after Intervention 3 with feedback to providers.

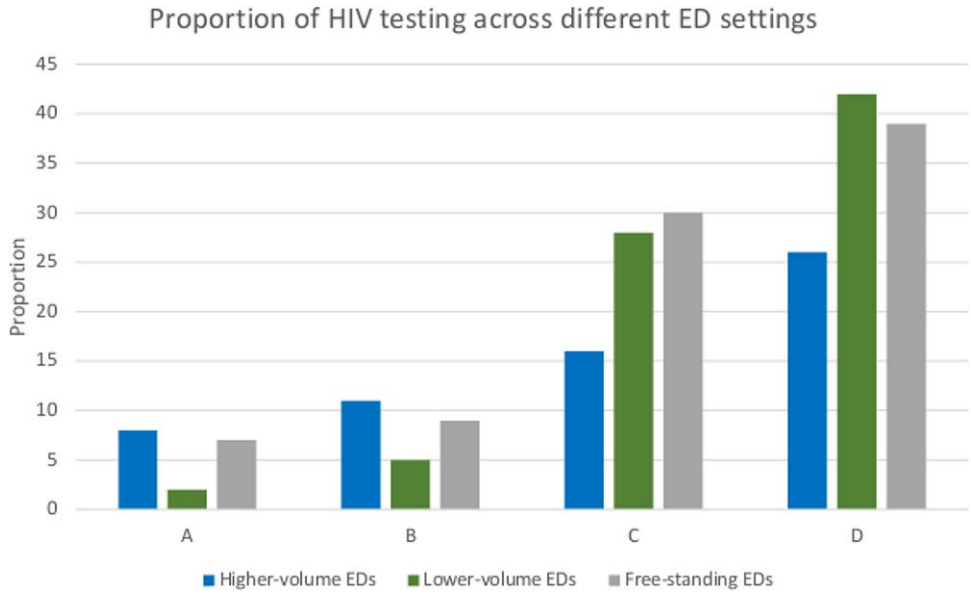

Figure 3. Proportion of human immunodeficiency virus (HIV) testing across different emergency department (ED) settings. Higher volume EDs include an urban, quaternary medical center, an urban community trauma center, a suburban community trauma center, and an urban community hospital. Lower volume EDs include 4 urban community hospitals and 2 suburban community hospitals. Free-standing EDs include 1 urban free-standing ED and 2 suburban free-standing EDs.

patient to relay test results, and time and expertise to adequately counsel patients about positive HIV results. In addition, it is essential that patients establish with HIV clinicians in a timely manner, because early connection to care has been shown to reduce morbidity of disease and new transmissions [2–5]. In this study, a multidisciplinary, multitiered intervention was implemented to increase testing rates while using existing ED and laboratory personnel.

Despite initial low proportions for HIV and syphilis testing during encounters at which GC/chlamydia were ordered, this study noted rates of increased testing after each intervention. After the final intervention, rates of testing for HIV and syphilis

were 36% and 39%, respectively, demonstrating a respective increase of 31% and 30%. These results were more pronounced in the free-standing and lower volume EDs. It is notable that free-standing and lower volume EDs do not have trauma centers. During the feedback sessions, ED clinicians who worked at both higher volume and lower volume EDs reported that the lower volume setting accommodated more laboratory testing because there was more time to provide initial counseling and follow-up test results.

Of note, there was a higher proportion of females included in this study because higher proportions of women undergo testing for GC/chlamydia due to the risk for pelvic inflammatory disease [28]. This is in line with current UPSTF recommendations for screening all sexually active women 24 years and younger and all women above the age of 24 who are at increased risk of STIs [29, 30]. After the interventions, there was an incremental rise in the proportion of male patients who were screened.

Overall, there was a marginal drop-off in GC/chlamydia testing annually from 2020, at which time 21 561 tests were ordered, compared to average testing rates in 2021–2022, during which 18 118 tests were ordered on average annually. Several studies have noted a similar phenomenon during the coronavirus disease pandemic [31–33], which was likely related due to increased self-isolation and a higher threshold for patients to present to the ED for STI testing.

The most significant rise in screening for both HIV and syphilis occurred after the deployment of the new STI order panel. The favorable results of this intervention highlight the importance of using order panels and selecting appropriate synonyms to facilitate rapid access.

Similar to this study, Lipps et al [34] demonstrated a collaborative approach between infectious disease and ED clinicians. The intervention entailed education materials to ED clinicians on testing, an STI order panel that included HIV and syphilis testing, and daily audit of HIV and syphilis results by ID clinicians. The study conducted by Lipps et al was implemented at an urban hospital ED and demonstrated a similar rise in HIV and syphilis testing as this study [34].

In contrast, the interventions in the present study were implemented across a large health system with diverse EDs as a change in system-wide practice that included new laboratory testing, a new workflow, and enterprise-level feedback provided on an annual basis. In addition, a central ID practice was able to successfully manage results from the regional hospitals. When ID clinicians received HIV-positive test results, connecting the patient to care and providing additional posttest counseling was a small addition to the workflow in ID clinic. This process was overseen by 1 ID provider and 1 social worker who helped with patient outreach. This resulted in a manageable workload for providers that was continued beyond the study period.

A study by Goetz et al [35] also used a multitiered intervention, which entailed provider and patient education with handouts and posters, quarterly feedback, and recruitment of opinion leaders to model new behaviors. Rather than screening all-comers for STIs, they identified patients at risk for STIs in the Veterans Health Administration via an EMR-based algorithm that triggered an automated prompt for screening. These interventions lead to a modest rise of 6.0% and 7.3% in testing rates at 2 separate testing sites that was possibly limited by reliance on reminders and provider activation.

Other groups have similarly utilized an electronic prompt to identify patients in need of HIV testing [12, 35–37]. However, several studies have raised concerns about reminder fatigue due to automated alerts or pop-up reminders [38–40]. Many clinicians perceive alerts in the EMR to be excessive [40] and are less likely to respond to reminders as more are deployed [38]. To avoid new alert reminders, the interventions in this present study were embedded in the ED workflow to minimize interruptions.

This study has several limitations. The scope of this study was limited to patients undergoing STI testing, as opposed to all patients who may have met recommendations for testing. Targeting all patients who met criteria would have required additional dedicated personnel and the use of automated alert reminders. In addition, this study took place in a state that has legislated opt-out testing. In accordance with CDC recommendations [26], "An HIV test may be performed by or on the order of a health care provider…if the individual…has given consent to the provider for medical or other health care treatment." [41] This study would be generalizable to hospital systems in states with similar legislation. All but 2 states now follow opt-out testing [26].

The scope of this study did not address ensuring STI checks at all exposure sites. Future interventions could address the implementation of full STI checks and expand the parameters for testing HIV and syphilis to capture more patients meeting criteria. This could include bundling STI testing with any pregnancy tests ordered. Future studies could also streamline referral of patients to ID clinics for PrEP initiation. In the future, CCHS will be hiring a social worker under the "Ending the HIV Epidemic in the U.S." initiative to provide outreach to patients with frequent STI testing in the ED to connect them to PrEP clinic.

CONCLUSIONS

In conclusion, a multidisciplinary approach to identify and overcome barriers to HIV and syphilis testing in the ED with interventions deployed across a health system in a multitiered series (including, the introduction of rapid HIV testing and linkage to care with ID, a streamlined STI order panel, and feedback to clinicians) resulted in a 5-fold and 3-fold increase

in HIV and syphilis testing, respectively, without the need for additional funding or personnel. The scalability of this multitiered intervention across a large hospital system may serve as a model to increase rates of HIV and syphilis testing in diverse health systems.

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Potential conflicts of interest. All authors: No reported conflicts of interest.

All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest.

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