

# The use of electronic medical records to prompt HIV testing

## Question

What are the best practices to prompt HIV testing using electronic medical records in health care settings?

## Key Take-Home Messages

- Canada has met The Joint United Nations Programme on HIV/AIDS (UNAIDS) goal of testing 90% of all people living with HIV; however, an estimated 6,950 people living with HIV remain undiagnosed (1, 2). Providing HIV testing that is both accessible and feasible remains critical to ensure high-risk individuals can be tested and people living with HIV can be linked to care (3).
- Non-targeted screening using electronic medical record (EMR) systems as alerts has shown to increase testing rates in hospitals (4), emergency departments (5, 6), and primary care practices (7).
- Utilizing an EMR to trigger an HIV testing alert in various health care settings has been used to effectively target individuals who are at a high risk of acquiring HIV (8–12). Health care settings that integrated EMR screening programs alongside indicator condition testing (12–14) and routine, opt-out HIV testing (11) observed an increase in screening rates.
- Emergency department overcrowding and failure to inform patients of their eligibility to receive HIV testing can decrease rates of EMR-driven HIV screening (15). Replacing an automatic HIV requisition ordering protocol with a manual entry can also decrease HIV screening, leading to missed HIV diagnoses (16).

## Rapid Response: Evidence into Action

The OHTN Rapid Response Service offers quick access to research evidence to help inform decision making, service delivery, and advocacy. In response to a question, the Rapid Response Team reviews the scientific and grey literature, consults with experts if required, and prepares a review summarizing the current evidence and its implications for policy and practice.

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## The Issue and Why it's Important

In 2020, the Public Health Agency of Canada reported that 4.3 cases of HIV were diagnosed for every 100,000 people in Canada and 3.5 cases of HIV were diagnosed for every 100,000 people in Ontario (17). The types of testing technologies used in Canada to detect HIV include rapid tests (e.g. point-of-care test, self-test), laboratory tests (e.g. antibody/antigen test), and confirmatory tests (e.g. Geenius™ HIV-1/-2 Confirmatory Assay, p24 antigen-only test, nucleic acid amplification test) (18). While a number of HIV testing technologies exist across the country, it is estimated that in 2020, approximately 90% of all people living with HIV (n=56,200 of 62,790) were diagnosed, leaving an estimated 10% (n=6,590) of people living with HIV unaware of their positive HIV status (1). In 2014, the United Nations set a target that by 2020, 90% of all people living with HIV would know their status (2); according to national 2020 data, Canada has achieved this goal (1). However, additional work must be done to further reduce the number of undiagnosed people living with HIV (1).

The Government of Canada has produced guidelines on individuals who should receive HIV testing (19). The established criteria are as follows:

- Individuals requesting an HIV test;
- Individuals presenting symptoms and signs of HIV infection or with illnesses associated with a weakened immune system;
- Individuals who are and have been sexually active and have never been tested for HIV;
- Individuals who have shared drug-use equipment with a partner who is HIV-positive or whose status is unknown;
- Pregnant women, or those planning pregnancy, and their partners, as follows:
  - Pregnant women and their partners with a risk of HIV exposure (individuals should be offered HIV testing at first pre-natal visit along with additional STI testing).
  - Pregnant women who test HIV-negative but who continue to be at risk of HIV acquisition during pregnancy could benefit from regular testing and testing at delivery.
  - Pregnant women who arrive for delivery without a prenatal test on record.

## References

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3. Kelly DV, Kielly J, Hughes C, Gahagan J, Asghari S, Hancock S, et al. Expanding access to HIV testing through Canadian community pharmacies: Findings from the APPROACH study. *BMC Public Health*. 2020;20(1):1-13.
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- Victims of sexual assault; and
- Individuals who have had unprotected anal or vaginal intercourse with a partner whose HIV status is unknown or HIV positive (19).

The guidelines also provide information regarding factors that are known to increase the risk of HIV acquisition (19). There are five primary identified risk factors: multiple partnering and/or anonymous sexual partnering; men having a history of sex with other men; a sexually transmitted infection diagnosis, or a diagnosis of another infection associated with HIV; sexual activity, sharing of drug-use equipment, or receipt of blood or blood products for people originating from, or who have travelled to regions with HIV is endemic; and, receipt of blood or blood products in Canada prior to the introduction of blood screening in November 1985 (19).

Providing accessible and feasible HIV testing remains critical to ensure people living with HIV are aware of their status and can be linked to care (3). The COVID-19 pandemic has been a barrier to individuals seeking care for sexually transmitted and blood-borne infections in Canada, including HIV (17, 20). A decreased demand for, and ability to provide, testing services was reported due to the pandemic, possibly impacting HIV diagnosis rates across the country in 2020 (17, 20). In addition to the COVID-19 pandemic, other barriers to HIV testing have been identified. A 2015 review presented evidence on HIV testing barriers for both patients and health care providers (21). Known barriers included a lack of perceived risk of HIV infection, discomfort discussing and lack of knowledge of HIV, health care provider time constraints, fear, stigma, and discrimination, insufficient access to testing, and financial and human resource constraints (21). Traversy et al. identified additional barriers to HIV testing, including a lack of specific training on how to test for HIV (21–24) and patient confidentiality concerns (21, 25–27).

Medical records have been utilized by health care providers to screen patients for infectious diseases, including HIV (4, 5, 7, 9–11), STIs (e.g. chlamydia, gonorrhoea, syphilis) (28–30), mental health conditions (31), and substance use disorders (31). There are two important types of patient medical records: EMRs and electronic health records (EHRs). An EMR is a provider-centric, partial health record that contains a portion of relevant health information about a person over their lifetime (32, 33). An EMR is typically considered to be an internal organizational system that stores institutional data, generated by one or more encounters in a care delivery setting (32). Alternatively, an EHR is a person-centric, complete health record under the custodianship of a health care provider(s) that contains all relevant health information about a person over their lifetime (32, 33). An EHR is recognized as an inter-organizational system that provides more complete data to physicians (32). These two terms are often used interchangeably throughout the literature. This review

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will not distinguish between EMRs and EHRs, and will use the term 'EMR' throughout to discuss electronic patient records.

Producing feasible, acceptable methods to assess and test individuals at risk of acquiring HIV is important in enhancing HIV service delivery and tackling the stigma and barriers that exist around HIV testing (3, 34). The utilization of EMRs in public health has shown to be effective; Willis et al. reviewed numerous articles published from 2018 to 2019 that discuss using EMRs for public health surveillance of infectious diseases, concluding that EMR data can "...enhance provider-based and laboratory-based disease reports and may facilitate more complete case reporting" (35). The use of EMRs in a clinical setting to address HIV testing, specifically in individuals presenting potential signs of HIV infection, will be explored in depth in this review.

## What We Found

### Non-targeted EMR HIV screening in health care settings

A 2018 retrospective cohort study was conducted from January 2012 to October 2015 in a large Boston medical centre to analyze the impact of implementing an EMR HIV screening prompt for all patients of the facility aged 18 to 65 who had at least one visit to the practice during the study period (7). Prior to EMR HIV screening reminder implementation, 15.3% of 27,729 patients who had never been previously tested for HIV were screened (7). After the integration of an EMR screening prompt, 30.7% of 20,640 patients who had never undergone HIV testing were screened (relative risk [RR]=2.02, 95% confidence interval [CI] 1.95–2.09) (7). Of all age groups evaluated, the EMR reminder had the largest impact on patients aged 46 to 65 (7). Pre-implementation, this group was the least likely to be screened for HIV; however, after implementation of the EMR HIV screening prompt, the proportion of patients tested increased from 9.7% to 27.2% (RR= 2.81, 95% CI 2.65–2.99) (7). Additionally, the EMR screening prompt had a greater influence on females than males; the proportion of females tested from pre-intervention to post-intervention was 14.0% to 30.5% (RR=2.19, 95% CI 2.10–2.30), whereas the proportion in males increased from 17.3% to 30.8% (RR=1.82, 95% CI 1.73–1.91) (7). Authors observed a 19.5% increase in the proportion of Black patients tested with the EMR prompt (RR=1.93, 95% CI 1.81–2.06), a 15.8% increase in Asian patients tested (RR=2.11, 95% CI 1.85–2.40), a 13.2% increase in White patients tested (RR=1.97, 95% CI 1.88–2.07), and an 18.8% increase in other races tested (RR=2.31, 95% CI 2.12–2.51) (7). Overall, the implementation of an EMR reminder roughly doubled testing in this medical centre, increasing HIV testing in many different demographics (7). Additionally, findings indicated that the EMR HIV screening reminder was more impactful in increasing testing rates for patients less likely to get screened (7).

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Another study published in 2017 examined the impact of an EMR prompt for HIV testing on hospitalized patients aged 21 to 64 in three New York adult hospitals between September 2013 and March 2015 (4). Prior to activation of the EMR screening reminder, 9.5% (n=3,486 of 36,610) of all patients had an HIV test performed, whereas 21.8% (n=4,122 of 18,943) were tested when the EMR intervention was in place (4). Among hospitalized patients with unknown HIV status, 11% (n=2,100 of 19,170) were tested before EMR HIV screening reminders were active, whereas 32.4% (n=2,979 of 9,202) were screened with the prompt (4). Furthermore, standard screening done prior to EMR testing yielded 8.2 HIV-positive diagnoses per 100,000 patient admissions (n=3) (4). Enhanced EMR HIV testing detected 37.0 HIV cases per 100,000 patient admissions (n=7), over 3.5-fold higher than pre-implementation HIV case detection (4). The authors concluded that the EMR HIV testing reminder increased HIV testing, which was also associated with the diversification of patients who were tested; patients among populations known to have low rates of testing were screened for HIV at an increased rate with the EMR-enhanced testing method (4).

Several studies utilizing EMR systems for HIV testing in emergency departments have been published recently and are described below.

- A 2019 publication of a Chicago emergency department used an EMR that would trigger for all sexually active patients aged 13 to 64 who did not have HIV on their health problem list, and had not undergone blood testing for HIV from May 2015 to January 2019 (5). To close the EMR, health care providers were required to inform patients of the HIV screening program and select if an HIV antigen/antibody test was to be performed on the individual (5). HIV antigen/antibody testing was performed on 17.1% of eligible patients (n=23,588 of 137,749), resulting in an overall test positivity rate of 0.70% (n=164) (5). The test positivity rate for newly diagnosed individuals was 0.29% (n=69) (5).
- A universal, routine, opt-out HIV testing program, Test, Educate, Support, and Treat Arizona (TESTAZ), was integrated into the Maricopa Medical Center emergency department in Arizona from July 2011 to June 2014 to screen patients aged 18 to 64 who were receiving blood work (6). A configurable EMR was integrated into the triage process to integrate custom documentation information specific to HIV testing (6). Patient demographic data were collected from EMRs, including gender, age, race, and insurance type; information on how many times the patient has been tested for HIV was also extracted (6). Using the data from the configurable EMR, screening rates were calculated: 57% (n=7,283) of 12,674 eligible patients were tested for HIV in the first year, 94% (n=12,728) of 13,518 eligible patients in the second year, and 98% (n=12,017) of 12,225 eligible patients in the third year (6).

15. Lin J, Baghikar S, Mauntel-Medici C, Heinert S, Patel D. Patient and system factors related to missed opportunities for screening in an electronic medical record-driven, opt-out HIV screening program in the emergency department. *Academic Emergency Medicine*. 2017;24(11):1358-68.
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Evidently, using EMRs to aid in screening for HIV can increase testing among many populations; however, researchers did not specifically target those at a high risk of HIV infection or showing symptoms of HIV, and instead implemented EMR reminders or systems to enhance testing for a general population (4–7).

## Targeted EMR HIV screening for high-risk populations in general care settings

Multiple studies have identified the benefits of integrating EMR systems and EMR HIV screening into health care settings. A 2021 study assessed EMR alerts for blood-borne virus testing in 14 general care practices in England where the intervention ran for six months in 2019 (8). An algorithm was created that searched for various items of data, such as abnormal test results (e.g. lymphopenia, raised alanine aminotransferase [ALT]), diagnostic codes (e.g. hepatitis, pneumonia, shingles), and repeat prescriptions, which may indicate that the patient is at a higher risk of having a blood-borne virus (8). The presence of any blood-borne virus risk factor without the patient having received appropriate testing would trigger the algorithm to provide a ‘soft prompt’ to the clinician, indicating that the individual may be at risk and should receive testing (8). Three or more risk factors detected by the algorithm would trigger a ‘hard prompt’ for HIV risk, which required a response from the clinician (8). Both types of prompts generated an integrated request form listing the blood-borne virus risk factors, recommending testing, and provided an area to record if the patient accepted or declined the test (8). Average testing of HIV increased by 555% with the implementation of the EMR alert; the testing rate in the six months prior to the intervention was 1.38 tests per 10,000 patients compared to the 7.67 tests per 10,000 patients in the six months following EMR alert integration (8). Patients and physicians both responded positively to the EMR testing alert (8).

A 2018 study reviewed the use of EMR alerts to remind clinicians to order HIV/STI tests in a large managed care organization in Southern California from January 2008 to June 2015 (pre-implementation period, January 2008 to June 2012; post-implementation period, January 2013 to June 2015) (36). These EMR alerts reminded clinicians to order HIV/STI tests for patients aged 14 or older with an unknown HIV status, or with no recent HIV test results, when ordering other STI tests (36). Same-day HIV testing increased from 36.7% (n=854,925) of 2,326,701 pre-EMR intervention patient encounters to 44.1% (n=600,719) of 1,362,479 post-intervention encounters (36). The HIV-positive test result rate before the EMR testing reminder was 0.02% (n=141 of 854,925), increasing to 0.04% (n=245 of 600,719) after the alert was implemented into the care organization (36).

20. Public Health Agency of Canada. Survey on the impact of COVID-19 on the delivery of STBBI prevention, testing and treatment including harm reduction services in Canada. 2022. Available from: <https://www.canada.ca/en/public-health/services/publications/diseases-conditions/survey-impact-covid-19-delivery-stbbi-prevention-testing-treatment.html> Accessed August 10, 2022.
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## Targeted EMR HIV screening for high-risk populations in hospitals and emergency departments

One prospective cohort study published in 2022 observed EMR alerts in one medical-surgical hospital in France between April 2018 and October 2019 (9). As patients were being admitted into the hospital, the admissions software would flag individuals when inadequate health coverage was provided and/or the patient was born in a high HIV-prevalence country, the alert appearing on the ward where the individual was hospitalized (9). Throughout the study period, 8,181 alerts were collected for 1,448 patients, though over 74.4% (n=6,087) of the alerts were directly closed (i.e. ignored); 14.5% (n=1,188) were closed due to physicians claiming they had no time to address and respond to the alerts (9). However, a requisition for HIV serology testing was given for 3.6% (n=297) of the 8,181 alerts, which corresponded to 20.5% (n=297) of the 1,448 patients (9). Overall, 61.3% of serology tests were conducted, two of which yielded a positive HIV result (9). Among all patients, 86.6% (n=543) had lower health coverage, and 69.7% (n=672) came from Africa (9). The authors highlight that EMR alerts for HIV testing is feasible and can help to better screen higher-risk populations (9).

From April to October 2019, the Department of General Medicine in a hospital in Japan integrated an EMR-based alert system that flagged high-risk patients eligible for HIV antibody testing (10). High-risk patients included those previously diagnosed with syphilis, hepatitis A, hepatitis B, and/or hepatitis C, and patients whose HIV status was unknown with an absence of HIV antibody test results in the last five years, or patients aged 20 to 50 with a prior shingles diagnosis, whose HIV status was unknown with an absence of HIV antibody test results in the last five years (10). Overall, 0.2% (n=47) of 22,264 patients who visited the emergency department were identified as high-risk (10). Of the high-risk patients who received HIV testing (29.8%; n=14), two were positive for HIV; both had previously tested positive for syphilis (14.3%) (10).

From November 2014 to July 2015, two algorithms were created to enable an EMR to detect patients presenting to the University of Illinois Hospital and Health Sciences System emergency department (11). The first algorithm was for the EMR to detect patients who meet the eligibility criteria created by the Centers for Disease Control and Prevention (CDC) for a once-in-a-lifetime routine, opt-out HIV screening: patients aged 13 to 64, with no prior documentation of an HIV diagnosis or HIV test (11). The second algorithm was developed to capture higher risk patients presenting to the emergency department and ensure they are screened more regularly than once in a lifetime, searching the EMR for any of the following: residence in a zip code with more than 1% HIV prevalence, men who have sex with men, intravenous drug use, homelessness, or unsafe sex (11). If these patients had not been screened for HIV in the past year, they were eligible for testing (11). Of the 3,866 patients who consented

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to screening after being flagged by the EMR system as eligible for HIV testing, 0.4% (n=16) received HIV positive results (11). After the EMR HIV screening program was implemented, the average number of tests performed in a month increased to 550 compared to seven prior to the intervention (11).

A 2021 systematic review examined indicator condition-guided testing for HIV in high-income settings, indicating that this type of screening is an effective way to identify undiagnosed people living with HIV (12). Only studies conducted in Western Europe, the U.S., Canada, Australia, New Zealand, and Japan were included as the HIV epidemiology and health care standards were comparable in these jurisdictions; a total of 57 studies were included (12). Tuberculosis, malignant lymphoma, hepatitis B, hepatitis C, cervical/vulvar carcinoma/intraepithelial neoplasia grade 2+, and peripheral neuropathy were the indicator conditions being observed throughout the systematic review, and many health care settings (e.g. emergency departments, primary care settings) were observed (12). The primary objective of the review was to assess the proportion of patients presenting with indicator conditions that are tested for HIV (i.e. the HIV test ratio) (12). The highest proportion of patients tested for HIV was with tuberculosis as the indicator condition, ranging from 44%–95% in hospital settings and 8% in primary care settings (12). No reports for vulvar carcinoma/intraepithelial neoplasia grade 2+ and peripheral neuropathy met the inclusion criteria (12). Two studies with a focus on hepatitis B and C that were eligible for inclusion using an EMR for HIV testing (12–14) are briefly covered below.

- From August 2008 to July 2009, patient data was collected on a number of conditions at a district general hospital in the UK to acquire verifiable data on the numbers of new diagnoses and HIV screening (12, 13). However, the systematic review described above only focused on hepatitis C (12). Gupta et al. ensured HIV testing was performed on patients of all ages diagnosed with hepatitis C using an EMR system and a separate HIV testing database, yielding an HIV test ratio of 19.4% (n=18) out of 93 patients (12, 13).
- A 2019 prospective interventional study observed the use of indicator conditions to guide HIV testing with the use of an EMR HIV screening prompt in three primary health care centres in Barcelona in 2015 (12, 14). The EMR flagged patients who were aged 18 to 65, had no documented HIV infection, and had a diagnosis of acute hepatitis B or C as eligible for HIV testing (12, 14). There was a significant rise in HIV test requests during the intervention implementation period, increasing from 12.6% pre-intervention to 35.6% with the EMR prompt (12, 14). However, the systematic review only included the pre-EMR intervention period, which yielded an HIV test ratio of 7.7% (n=2 of 26 patients) (12, 14).

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The definition of “high-risk” varied throughout the literature when EMR HIV screening was used to target “high-risk” populations. A 2022 article addressing HIV testing in high-risk populations in an emergency department in St. Louis defined high-risk individuals using a 2013 U.S. Preventative Services Task Force definition: “The U.S. Preventive Services Task Force (USPSTF) recommends that clinicians screen all adolescents and adults aged 15 to 65 years for HIV infection. Younger adolescents and older adults who are at increased risk should also be screened.” (37, 38). This definition did not change when the 2013 U.S. Preventative Services Task Force updated their recommendations in 2019 (38, 39). Conversely, the study conducted in Japan that was previously mentioned, defined high-risk patients as “1) patients who are positive for serologic test of syphilis (STS), *Treponema pallidum* hemagglutination (TPHA), IgM for hepatitis A virus (IgM-HAV), hepatitis B surface antigen (HBsAg), or hepatitis C virus (HCV) antibody, and whose HIV infection status is unknown with an absence of HIV antibody test results documented in the EMR in the recent 5 years; or 2) patients aged between 20 and 50 years old who have shingles diagnosis and whose HIV infection status is unknown with an absence of HIV antibody test results documented in the EMR in the recent 5 years.” (10). Thus, there may be difficulties comparing and interpreting different EMR strategies due to the varying definitions of “high-risk” HIV populations.

## Consequences and missed opportunities of electronic medical records and HIV testing

The usefulness of EMRs has been consistently stated in the literature (4, 5, 7, 9–11). However, there continue to be missed opportunities for HIV screening in EMR-driven studies.

One study looked at targeted and non-targeted, EMR-driven HIV screening from November 2014 to July 2015 in the University of Illinois Hospital and Health Sciences System emergency department (15). The EMR qualified a patient as eligible for non-targeted screening if they were aged 13 to 64 and had no recorded HIV diagnosis or HIV testing history (15). For targeted screening of patients at a higher risk of HIV infection, the EMR identified eligible individuals as those that match the following eligibility criteria:

- aged 13 to 64,
- no record of an HIV diagnosis,
- no record of HIV testing within the past year, and
- any of the following risk factors documented within EMR search fields:
  - residence in a zip code with greater than 1% HIV prevalence,

36. Hechter RC, Bider-Canfield Z, Towner W. Effect of an electronic alert on targeted HIV testing among high-risk populations. *Permanent Journal*. 2018;22:18–015.
37. Bitter CC, Parmentier M, Subramaniam DS, Byrne L, Buchanan P. An electronic health record alert increases human immunodeficiency virus screening and case identification in a high-risk emergency department population. *International journal of STD & AIDS*. 2022;33(7):722–5.
38. Moyer VA. Screening for HIV: US preventive services task force recommendation statement. *Annals of internal medicine*. 2013;159(1):51–60.
39. Owens DK, Davidson KW, Krist AH, Barry MJ, Cabana M, Caughey AB, et al. Screening for HIV infection: US preventive services task force recommendation statement. *Journal of the American Medical Association*. 2019;321(23):2326–36.

- male, and
- sexual orientation of homosexual or bisexual, intravenous drug use, homelessness, or unsafe sex (15).

These eligibility criteria are similar to a previously mentioned study conducting research in the same Illinois emergency department (11). Patients matching the above criteria were classified to be at a higher risk of HIV infection and an EMR alert was triggered, indicating their eligibility for HIV testing (15). In the emergency department, nurses were required to inform all patients who were eligible for HIV screening and who were having blood drawn as part of their emergency department care, and were encouraged to inform eligible patients who were not receiving blood work to have blood drawn specifically for HIV testing (15). Only one in five patients eligible for HIV testing were tested at the emergency department, and only 53% of patients eligible for HIV screening had their blood drawn (15). Younger patients were less likely to have blood drawn than older patients; 19% (n=1,059) of 5,550 eligible patients aged 13 to 29 consented to having their blood drawn for HIV testing compared to 26% (n=1,092) of 4,197 eligible patients aged 50 to 64 (15). Additionally, eligible patients were less likely to have their blood drawn when the emergency department crowding status was “overcrowded” (odds ratio [OR]=0.8, 95% CI 0.7–0.9), “severe” (OR=0.6, 95% CI 0.5–0.7), or “disaster” (OR=0.6, 95% CI 0.4–0.7) compared to “normal” (15). Finally, patients aged 13 to 19 had one of the lowest rates of consent (64%); authors highlight the need to increase the likelihood of eligible patients being informed about routine HIV testing to avoid missed testing opportunities and for this EMR-driven HIV screening technique to be optimal (15).

## Factors That May Impact Local Applicability

Most studies observed in this review were conducted outside of Canada, many having been performed in the U.S. or UK. HIV screening recommendations vary between countries; therefore, identifying patients with high risk behaviour and/or classifying individuals eligible for HIV testing may pose challenges when interpreting and generalizing results to Ontario. Additionally, different HIV testing measures and statistics have been reported throughout the studies, possibly causing difficulties when comparing the measures.

## What We Did

We searched Medline using a combination of (text terms [electronic medical record\* or Electronic Health Record\*] or MeSH terms [Medical Records Systems, Computerized/ or Electronic Health Records/] or [EMR\* or EHR\*] in titles or abstracts) AND HIV in titles or abstracts AND (test\* or screen\*) in titles or abstracts.

Searches were conducted on July 27, 2022 and results limited to English articles published from 2010 to present. Studies from low- and middle-income countries were excluded. Reference lists of identified articles were also searched. Google (grey literature) searches using different combinations of these terms were also conducted. The searches yielded 363 references from which 39 were included.