HIV Care Continuum for HIV-Infected Emergency Department Patients in an Inner-City Academic Emergency Department

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Study objective: The recently released HIV Care Continuum Initiative is a cornerstone of the National AIDS Strategy and a model for improving care for those living with HIV. To our knowledge, there are no studies exploring the entirety of the HIV Care Continuum for patients in the emergency department (ED). We determine gaps in the HIV Care Continuum to identify potential opportunities for improved care for HIV-infected ED patients.

Methods: A mixed-methods approach was used in 1 inner-city ED in 2007. Data elements were derived from an identity-unlinked HIV seroprevalence study, an ongoing nontargeted HIV screening program, and a structured survey of known HIV-positive ED patients.

Results: Identity-unlinked testing of 3,417 unique ED patients found that 265 (7.8%) were HIV positive. Of patients testing HIV positive, 73% had received a previous diagnosis (based on self-report, chart review, or presence of antiretrovirals in serum), but only 61% were recognized by the clinician as being HIV infected (based on self-report or chart review). Of patients testing positive, 43% were linked to care, 39% were retained in care, 27% were receiving antiretrovirals, 26% were aware of their receiving antiretroviral treatment, 22% were virally suppressed, and only 9% were self-aware of their viral suppression.

Conclusion: To our knowledge, this study is the first to quantify gaps in HIV care for an ED patient population, with the HIV Care Continuum as a framework. Our findings identified distinct phases (ie, testing, provider awareness of HIV diagnosis, and linkage to care) in which the greatest opportunities for intervention exist, if appropriate resources were allocated. This schema could serve as a model for other indolent treatable diseases frequently observed in EDs, where continuity of care is critical. [Ann Emerg Med. 2015;66:69-78.]

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INTRODUCTION

HIV transmission directly depends on HIV viral load.[1,2] Viral suppression can be effectively accomplished through antiretroviral therapy.[3] Achievement of undetectable viral load is recommended as the ultimate goal for HIV prevention and control.[2] There are 5 steps in the HIV Care Continuum required for reaching undetectable viral loads for patients infected with HIV: initial HIV diagnosis, linkage to care, retention in care, receipt of antiretroviral therapy, and achievement of a low viral load at undetectable level. The importance of this conceptual framework was first quantified by Gardner et al[4] in a landmark study that depicted the full spectrum of HIV care across the United States, reporting that only 19% of the population reach that target. That study used data from diverse patient populations, varied geographic regions, and multiple years, yielding a relatively simple model for defining the gaps at each step along the continuum.[5] In accordance with that schema, President Obama issued an executive order in 2013, the HIV Care Continuum Initiative, which was directed toward accelerating improvements in HIV prevention and care across the United States.[6,7] Since then, many investigators have applied this framework in different settings to identify gaps along the continuum to assess where, when, and what resources could best be applied to improve HIV care.[8-13] To date, to our knowledge there

Editor's Capsule Summary

What is already known on this topic
The HIV Care Continuum describes 5 steps to optimize the care of infected patients.

What question this study addressed
The performance of emergency department (ED)–based HIV programs relative to the continuum is not known. Data from 3 studies in an urban academic ED were assessed to identify shortfalls.

What this study adds to our knowledge
Gaps were found in retention (61%), receiving antiretroviral therapy (73%), and viral suppression (78%). Three new steps for improving care were also identified.

How this is relevant to clinical practice
Optimizing adherence to the continuum model may improve ED-based HIV care and may assist in the development of similar models for chronic diseases.

have been no studies evaluating the HIV Care Continuum from an emergency department (ED) perspective.

For more than a decade, EDs have been playing a critical role in HIV testing efforts,[14,15] with thousands of previously undiagnosed HIV-infected individuals identified (principally by dedicated HIV testing programs).[16] Because EDs also function as a safety net for more than half a million individuals living with HIV,[17] many of whom use the ED as their only source of care, potential opportunities for affecting other aspects of HIV care exist. ED-based HIV testing initiatives have already been shown to be effective for identifying patients with undiagnosed HIV and linking patients with new diagnoses to primary or HIV specialty care. In practice, emergency clinicians also routinely establish or reestablish care for patients with known HIV infection, which frequently includes ensuring that patients are receiving appropriate antiretroviral therapy. The ability to reliably assess the clinical status of ED patients with HIV (both recognized and unrecognized) in relation to the stated goals of the HIV Care Continuum is important, given that the ED is frequently the primary or sole point of entry into the health care system for those patients.[18] Gaps in provider knowledge, such as recognition of a patient's HIV serostatus, antiretroviral adherence, and stage of disease, may affect management decisions for patients with HIV. Reasons for these knowledge gaps are varied and include limitations in ability to test patients in some EDs,

relative lack of availability of clinical information, and variable patient self-reporting about HIV diagnosis, treatment, and extent of viral suppression.

The objective of this study is to determine gaps in the HIV Care Continuum to identify potential opportunities for improved care for patients with HIV who visit the ED, and to target aspects of our own screening program where potential opportunities for improvement exist. Establishing a framework for an ED HIV Care Continuum can also serve as a prototype for investigators who are studying other indolent chronic infectious or noninfectious diseases that are frequently undiagnosed or undertreated. The data for informing our ED care continuum model were derived from a single urban academic ED using multiple data sources from a single calendar year, permitting a more reliable assessment of this environment. We also propose and highlight 3 new operationally defined stages along the care continuum that are relevant to ED settings: (1) provider awareness of HIV diagnosis, (2) patient receiving antiretroviral treatment—patient self-aware, and (3) viral load suppression—patient self-aware. These proposed additional "stages" are particularly relevant to settings in which the clinicians or patient may have incomplete information related to the patient's disease state and have downstream consequences for both individual and population-based control of HIV/AIDS.

MATERIALS AND METHODS

The studies were conducted at an academic, inner-city, adult ED with 60,000 visits (in 2007) that primarily serves a local socioeconomically disadvantaged population in Baltimore City, MD. Our ED has a high prevalence of HIV infection and has nearly 2 decades of experience in HIV testing, treatment, and follow-up.[19-24] Beginning in 2005, we instituted an ED-based rapid HIV screening program.[25]

During the summer and fall of 2007, we conducted 3 simultaneous HIV studies in our ED: an identity-unlinked HIV seroprevalence study, a programmatic evaluation of an established ED-based rapid HIV screening program, and a cross-sectional survey study of known HIV-positive patients, designed to assess their experience with HIV care. A mixed-methods approach was used to develop the estimates for each stage of the HIV Care Continuum. All 3 studies were approved by the Johns Hopkins University School of Medicine Institutional Review Board.

Study 1 was an HIV identity-unlinked seroprevalence study conducted from June 23, 2007, to August 18, 2007, which included all ED patients aged 18 years or older who had blood drawn for clinical procedures. During the study period, there were 9,179 ED visits. Among them, there were 4,475 patients for whom unused excess blood specimens

were collected. The identity-unlinked seroprevalence study methodology has been well described in the literature[19] and involved collection of excess sera as part of clinical procedures, assigning of a unique study code, and removal of all identifiers and protected health information from samples after collection of basic data (eg, age, sex, race, risk factors). For each patient from whom blood was obtained, the blood sample and the data collected were labeled with unique code numbers. The data collected excluded all forms of patient identification and associated protected health information. Thus, no result could be traced to any specific patient, and protected health information was not available in the study database.

Chart reviews for study 1 were undertaken in a specific, structured manner, using generally suggested methods for chart review that have been widely published in the emergency medicine literature.[26] These methods were used in previously published HIV research in this ED.[19,20] Five trained research assistants participated in the study design and development stages of the project. The design of the standardized data abstraction format was based on our previous published studies.[19,20,24] An electronic data abstraction form was created with hard stops and parameters intended to maximize data accuracy (eg, age parameters, binary response choices where appropriate). Structured data forms defined specific variables, which were extracted from the ED chart and the electronic medical record. The research staff received training in clinical research methods, chart review, and laboratory methods before collecting any data. Staff were supervised throughout the design and collection period by a senior research staff member with formal graduate-level research training. A senior clinical research staff member with graduate-level research training did spot-checking of the data collected by each research assistant. No formal interrater reliability assessment was performed. Weekly study meetings were held to address specific data collection issues such as discrepancies in data available in the chart, from the patient, and in the electronic medical record. Discrepancies were adjudicated by consensus of the senior faculty investigator on the study team.

For used clinical blood samples, deidentified samples were tested for HIV by third-generation HIV enzyme immunoassays; positive results were confirmed by Western blot followed by ribonucleic acid viral load testing with Roche Amplicor (version 1.5; Roche, Indianapolis, IN), which has a limit of detection of 400 copies/mL. Known HIV positivity was determined by either chart review or self-report as part of the HIV screening program, and data were collected before deidentification. Antiretrovirals in serum specimens were detected with ultraperformance liquid chromatography–tandem mass spectrometry by the

Clinical Pharmacology Laboratory at the Johns Hopkins University.[27] These tests detect the presence of antiretrovirals in the serum specimens among the majority of individuals receiving antiretroviral therapy. Specifically, the following analytes of antiretrovirals were tested: Amprenavir, atazanavir, darunavir, efavirenz, indinavir, lopinavir, metabolite of nelfinavir, nelfinavir, nevirapine, ritonavir, saquinavir, and tipranavir. Thus, all the preferred and alternative regimens of antiretroviral therapy were tested except for zidovudine/lamivudine/abacavir, which was not a recommended regimen in 2007. Results of this HIV seroprevalence study have not been previously reported in the peer-reviewed literature.

Study 2 was a nontargeted rapid HIV screening program initiated in this ED in 2005 and used the OraQuick Advance Test (OraSure Technologies, Bethlehem, PA). During July and August 2007, an exogenous staffing model (ie, HIV testing facilitator based) was used. Thirteen trained testing facilitators working in shifts offered HIV testing to eligible ED patients, 24 hours a day, 7 days a week. Facilitators, who were not part of the medical treatment team, consented patients, performed brief pretest counseling, collected oral specimens, disclosed test results, and performed posttest counseling. Rapid tests were run in the on-site ED clinical laboratory by laboratory staff. A dedicated HIV program coordinator was responsible for linkage to care for any patients with newly diagnosed HIV. During this period, 1,173 ED patients were tested for HIV. Seven newly diagnosed cases were identified and 4 (57%) patients were successfully linked to care. From August 2006 to June 2007 and September 2007 to December 2007, a hybrid staffing model in which the ED-based rapid HIV screening program was staffed, which included both exogenous facilitators and indigenous medical staff (based on time of day and day of week). During this period, 1,332 ED patients were tested, 27 received a new diagnosis of HIV infection, and 16 (59%) were successfully linked to care. Together, from August 2006 to December 2007, 31 patients with newly diagnosed HIV were identified from our ED HIV screening program and 20 patients (59%) were linked to care. Details of the testing program and a subset of the linkage to care data have been described and reported elsewhere.[25]

Study 3 was a structured survey of known HIV-positive ED patients, conducted in the same ED during July and December of 2007. That investigation was designed to assess various aspects of patients' impression of HIV care from self-report, including frequency of scheduled HIV care in the past 12 months, receipt of antiretroviral medication, and most recent range of viral loads. One hundred seven patients were enrolled; details of this survey

have been previously described.[28] Briefly, known HIV-positive ED patients were eligible for this pilot study if they were not critically ill or were capable of providing informed consent. At enrollment, participants completed an interviewer-administered structured questionnaire about their demographic, behavioral, and clinical characteristics, as well as health care information, including age, race, sex, highest level of education achieved, employment status, income level, housing condition, sexuality, injection drug use, types of medical insurance, HIV-related health care information, length since initial HIV diagnosis, antiretroviral drug use, and comorbid conditions. Most recent HIV viral load information (undetectable, detectable but <5,000, 5,000 to 99,999, ≥100,000 copies/mL, or unknown/unsure) was also collected by patient self-report in the questionnaire. HIV antiretroviral treatment and viral load information used as data sources for this study have not been reported in the literature.[28]

Key data elements from the 3 studies or programs described above were used to estimate the numbers for each stage of the HIV Care Continuum for our ED in 2007. We used total number of HIV-infected ED patients identified in the seroprevalence study (study 1) as the first stage of the HIV Care Continuum and then estimated the remaining numbers in stepwise progression. First, we estimated the number of patients who had previously diagnosed HIV infection, defined according to either chart documented or self-reported HIV-positive status, or the presence of antiretrovirals in the specimen from the seroprevalence study. Next, we used the proportion of successful linkage to care from our 2007 screening program (study 2) to estimate the numbers of HIV-positive patients linked to care. Then, we estimated the retention in care number by applying the proportion estimated from the survey study (study 3). We next estimated the number of patients in treatment (according to presence of antiretroviral in serum) and who were virally suppressed (from direct viral load data). We also estimated provider and patient awareness of the stages along the HIV Care Continuum. An aware HIV diagnosis (with awareness defined from the perspective of the ED provider) was determined with data from the seroprevalence study (infection was chart documented) or from the screening program (patient self-reported positivity to testing facilitator staff). The number of patients self-aware about antiretroviral treatment was determined according to the proportion of known HIV-positive patients in care who reported that they were receiving antiretroviral treatment (study 3), using the number of patients retained in care as the denominator. Similarly, the number of patients self-aware that they were virally suppressed was determined by the proportion of known

HIV-positive patients in care who reported their viral loads to be at an undetectable level (study 3), using the number of patients retained in care as the denominator. The 95% confidence interval (CI) of each data element from the 3 studies or programs described above was calculated. A sensitivity analysis was performed to provide the upper and lower bounds of each estimate for each stage of the HIV Care Continuum, using upper and lower limits of the 95% CI for each data point from 3 data sources.

Operational definitions that were derived from the literature or authors' consensus were as follows: An HIV infection was defined as a reactive HIV enzyme immunoassay test result confirmed by Western blot. A diagnosed infection was defined as chart-documented HIV infection, self-reported infection from the screening program, or the presence of antiretrovirals in the serum specimen. Provider awareness of HIV diagnosis was defined as either chart-documented HIV infection or self-reported infection from the screening program, indicating that the treating provider was likely aware of the patient's HIV serostatus. Self-awareness of antiretroviral treatment and self-awareness of undetectable viral loads were taken from self-reported information from the known HIV-positive survey described above. Linkage to care was considered unsuccessful if there was no documented evidence of a patient with confirmed positive results entering into care within 6 months of the initial reactive ED rapid test result despite 2 attempts at follow-up by the program coordinator.[25,29,30] Retention in care was defined as at least 2 scheduled clinic visits for HIV care in the past 12 months, as reported by survey participants from study 3.[28,31,32]

RESULTS

The estimated numbers for each stage of the HIV Care Continuum from this ED in 2007 are presented in the Figure. From the identity-unlinked seroprevalence study (study 1), 265 of 3,417 unique subjects (7.8%) presenting to the ED were identified as HIV infected. Of these, 192 (72.5%; 95% CI 66.8% to 77.6%) patients were considered as having diagnosed infections: 162 (61.1%; 95% CI 55.2% to 66.9%) were either chart documented or self-reported as HIV positive (ie, provider awareness of HIV diagnosis); an additional 30 patients (11.3%) whose HIV-positive status was not documented or reported to the facilitator staff had antiretrovirals detected in their serum sample.

Applying the observed 59% (95% CI 41.9% to 74.3%) successful linkage to care proportions for newly diagnosed infections from our 2007 HIV screening program, we estimated that 113 patients (43%) of the 192 patients with HIV-positive diagnosis were linked to care. Next, applying
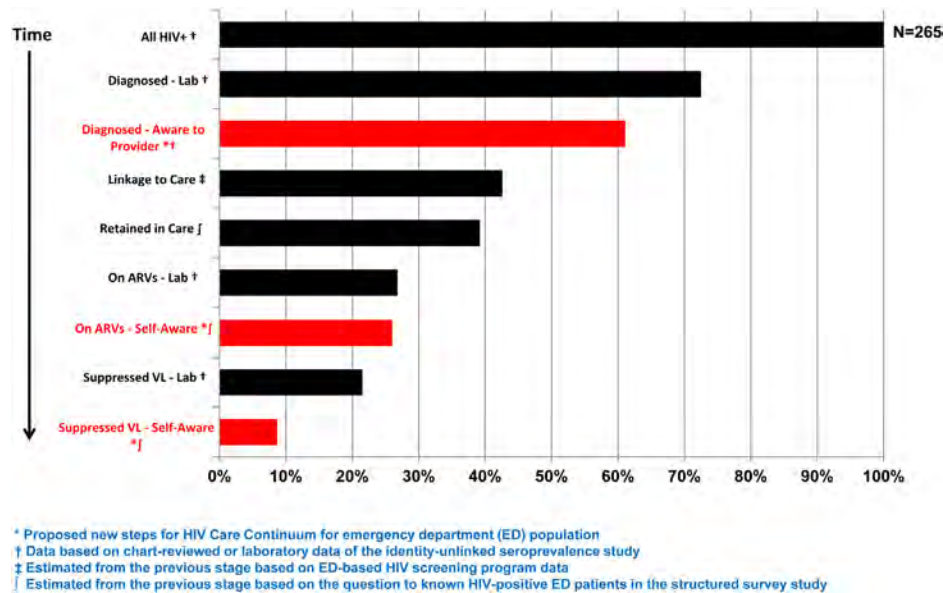
Figure. HIV Care Continuum with introduction of 3 new operationally defined stages for HIV-infected ED patients in an inner-city adult ED in 2007. *ARV*, Antiretroviral; *VL*, viral load.

an observed retention to care proportion of 64.5% (95% CI 55.1% to 73.1%) of the total 162 patients who were documented or self-reported to be HIV positive (study 3 data, HIV-positive ED patient survey), we estimated that 104 of 265 patients (39%) were retained in care, or 92% of those patients linked to care were retained in care.

Our laboratory data found that 71 of 265 HIV-positive patients (27%; 95% CI 22% to 32%) were currently receiving antiretroviral treatment. Taken together with the survey data, which found that 66.7% (95% CI 55.0% to 77.0%) of known HIV-positive patients in care reported currently receiving antiretroviral treatment, we estimated that 69 of 265 HIV-positive patients (26%) were self-aware of their treatment. Finally, our antiretroviral testing data demonstrated that 57 of 265 patients (22 %; 95% CI 17% to 27%) were virally suppressed, yet only 23 (9%) were estimated to be self-aware of being virally suppressed. This latter estimate is based on survey data indicating that 21.7% (95% CI 13.2% to 32.6%) of known HIV-positive patients who reported being in care understood that they had undetectable viral loads.

In regard to the 3 proposed new operationally defined steps along the HIV Care Continuum, a substantial proportion of patients in the ED who were infected with HIV were found to have gaps (communication or knowledge) related to their care status. That is, in the step "provider awareness of HIV diagnosis," 15.6% of providers (30/192) were unaware their patient was HIV infected, and in the step "viral load suppression—patient self-aware," 59.6% of patients (34/57) were unaware that they were

virally suppressed. For the step "patient on antiretroviral treatment—patient self-aware," all but 2 patients (97.2%) were self-aware of their antiretroviral treatment status.

The upper and lower bounds of our estimate for each step of HIV Care Continuum by sensitivity analysis are presented as follows. Among all 265 HIV-infected ED patients, 67% to 78% received a diagnosis (ie, 22% to 33% of all infections were undiagnosed), 55% to 67% were "provider awareness of HIV diagnosis", 30% to 54% were linked to care, 30% to 49% were retained in care, 22% to 32% were receiving antiretroviral treatment, 17% to 37% were self-aware of antiretroviral treatment, 17% to 27% were viral suppressed, and 4% to 16% were self-aware of viral suppression.

LIMITATIONS

This study has several limitations. First, this is a cross-sectional snapshot of the HIV Care Continuum in 1 adult ED with a high seroprevalence of HIV in the population. Most US EDs have a lower prevalence of infection. Additionally, the ED population in our study has had a dedicated ED-based HIV testing program in place since 2005, with feasibility demonstration programs dating back to 1995.[33] Therefore, our results might not be generalizable to EDs with a lower HIV seroprevalence or those with less dedicated or sustained ED-based HIV testing resources. Still, because our ED has been one of the nation's epicenters for conducting ED-based epidemiological and clinical studies of HIV,[19,23,25,28,33] our findings do provide important proof-of-concept data about the potential role

that EDs provide in addressing the HIV Care Continuum. The framework presented could also serve as a prototype for other investigators or policymakers involved in ED-based efforts for HIV testing and linkage to care.

Second, similar to the original HIV Care Continuum described by Gardner et al,[4] our care continuum estimates were not derived from longitudinal data from a cohort of HIV-infected patients. Instead, the data we present are from 3 studies conducted in parallel in a single ED. The simultaneous conduct of the studies (all in a single year) makes it likely that the 3 study populations came from a common and relatively fixed or static population[34]; this makes these estimates even more reliable than those used to model the original HIV Care Continuum, which were drawn from multiple populations in different geographic regions and settings during a span of more than 10 years.[4]

Third, it is possible there were some patients who should have been labeled as having diagnosed HIV infection but were not categorized appropriately. Instances in which this may have occurred include (1) patients for whom the HIV-positive status was not documented in the medical charts at our institution; (2) patients who chose not to disclose their positive status to our HIV screening program staff; or (3) HIV-infected patients who were not receiving antiretrovirals (ie, absence of antiretrovirals in their serum specimens). Therefore, our number of undiagnosed infections could be overestimated.

Fourth, translating our estimates of the HIV Care Continuum for our ED patients should be made with caution because the data were gathered in 2007. Advances occurred since then, which could affect these estimates, including improvement in HIV testing diagnostics, namely, use of fourth-generation HIV enzyme immunoassay assay, which shortens the pre-seroconversion window period; improvements in our ED screening program, which has increased the proportions of patients who were offered and were tested for HIV; introduction of a more active linkage to care protocol, which includes use of dedicated case management; active involvement of our affiliated HIV clinic staff, which has yielded improved retention in care and adherence to antiretroviral treatment; more aggressive antiretroviral treatment guidance; and enhanced efficacy of antiretroviral regimens for suppressing HIV viral loads. Taken in combination, these factors likely would produce a different picture of the metrics shown here for an ED-centric HIV Care Continuum than the one described herein. Still, these 2007 estimates provide a useful framework for understanding factors that contribute to the HIV Care Continuum, as well as a baseline set of comparator data for making improvements to our HIV screening program.

Fifth, our estimates of the HIV Care Continuum in our ED are potentially limited by biases inherent to individual data sources, including selection bias associated with laboratory specimens (eg, which patients had blood drawn and available for the identity-unlinked seroprevalence study), demographic or clinical data obtained from chart review (eg, absence of systematic documentation of HIV positivity on patient's chart and absence of information about HIV care outside of our institution), and information biases from our surveys (eg, HIV serostatus and self-report about treatment and viral suppression in the absence of confirmation from chart review). The magnitude of these selection and information biases cannot easily be estimated. Specifically, our HIV prevalence estimates were made from patients who were aged 18 years and older and had blood drawn as part of their ED care. Accordingly, it is possible that the true HIV prevalence is higher or lower. Thus, we were not able to adjust for selection and information biases derived from individual data sources.

DISCUSSION

The study is the first, as far as we are aware, to define gaps in the spectrum of HIV care and the associated missed opportunities along each stage of the HIV Care Continuum for an ED patient population. Compared with estimated figures described in the original national HIV Care Continuum, which used multiple data sources from the late 1990s to 2008,[4] our 2007 ED data found that HIV-infected patients who visited this ED had slightly higher estimated proportions of undiagnosed infection (27% versus 21%) and lower proportions of linkage to care (43% versus 59%) but similar proportions of retention in care (39% versus 40%), antiretroviral treatment (27% versus 24%), and viral suppression (22% versus 19%). These findings provide a framework and a starting set of data for future ED investigators conducting HIV-related research to consider.

The HIV Care Continuum has been widely described for internal medicine, infectious disease, and public health audiences but is a relatively new concept for emergency medicine. In the past decade, there has been a large investment in dedicated public health resources and focused ED investigation directed toward optimizing ED-based HIV testing, referral, and linkage to care processes. Some in the ED community considered this investment as a laudable goal[35,36] because many ED patients may not receive testing elsewhere, and early identification of infected patients is beneficial for future patient management and treatment.[37] However, as highlighted in the original HIV Care Continuum schema,[4] testing and linkage to care are

only 2 stages of the HIV care cascade. Although few question the important role EDs are already playing in initial HIV diagnosis and early linkage to care, our role in attending to downstream stages along the care continuum has never been addressed.

What is the influence EDs could potentially have in both individual HIV illness and community HIV transmission, were we to engage in other aspects of the HIV Care Continuum such as relinking patients who have ceased care,[38] encouraging retention in care, or counseling adherence to antiretroviral treatment? Conceptually, this introduces discussion, and likely some controversy, about the appropriate balance between providing emergency or urgent care for ED patients and providing continuity of care services. An important consideration is recognition that such downstream services (for example, adequate viral suppression) are tied to future ED and inpatient resource use, metrics that are receiving increased national attention. Multiple other questions must be considered in applying these findings to practice, however, such as what are the external resources (eg, funding, manpower, infrastructure) required to support such activities, and from where will they be drawn? In this regard, even the existence of the most basic ED-based HIV testing programs has been hotly debated in the literature[39,40] since EDs were first listed as one of the key health care sites for testing in the 2006 Centers for Disease Control and Prevention recommendations for HIV testing.[41] Although compelling data support some form of ED-based screening,[42] it remains to be determined what approach is optimal for individual EDs and whether such efforts are truly sustainable for the long term.[15,43] Thus, although the conceptual framework of the HIV cascade may make sense from a broad clinical and public health perspective, feasibility studies are needed, and ultimately expert consensus is required for developing pragmatic guidance about what role, if any, EDs can or should play at each stage along the HIV Care Continuum.

Identifying undiagnosed HIV infection, ie, testing, is the first step in the cascade of the HIV Care Continuum and the most critical for achieving high levels of viral suppression in the population (ie, viral suppression will be limited if there are significant numbers of individuals with undiagnosed disease, even if there were no or few gaps along the remaining steps of the cascade).[4] Despite the presence of our long-standing ED HIV screening program,[25] in which 0.5% to approximately 2% of ED patients tested for HIV had newly diagnosed infection, a substantial proportion of HIV infections remained unrecognized. Specifically, we found that 27% of HIV infections in all HIV-infected patients were previously undiagnosed. Such a high

proportion of undiagnosed infections likely results, at least in part, from the high prevalence of HIV (11% to 12% in 2001 to 2003) in the community our ED serves. This drives HIV transmission and is reflected in the observed HIV incidence of 0.5% to 1% per year.[24] Another possible explanation for the high prevalence of undiagnosed infections reported here is that implementation and uptake of HIV screening were not sufficiently comprehensive when study was conducted (2007). That possibility is supported by findings from a separate study from that same year, in which we discovered 10-fold higher prevalence of undiagnosed HIV among ED patients who were not offered testing and 5-fold higher prevalence of undiagnosed cases among patients who were offered but declined testing versus those who accepted testing (in which the prevalence was 0.4%).[44] Still another possible explanation for the high prevalence of undiagnosed infections observed in our ED is that some individuals who we considered as having undiagnosed infections did in fact have acute HIV infections, which we were not able to recognize with the OralQuick rapid HIV test platform, which has a longer pre-seroconversion window period than the newer fourth-generation HIV testing technologies.[45] Finally, it is possible that some cases we considered undiagnosed infections were actually previously diagnosed but inappropriately categorized because of either nondisclosure of serostatus by the patient or inadequate chart documentation.

Successfully linking a patient with newly diagnosed HIV infection to care is a complicated and multifactorial process that can be challenged by both patient- and system-level barriers. The proportion of our patients who were linked to care at this study (approximately 60% of those with new diagnosis) is relatively lower than that which has been observed more recently, as reported in a meta-analysis that found that 76% of HIV-positive patients tested from EDs and urgent care settings were successfully linked.[30] The most likely explanation for the relatively low proportion of patients who were linked to care (in 2007) was the fact that we used a relatively passive approach to follow-up care, which consisted of calling the clinic to arrange the next available appointment and up to 2 follow-up calls after missed appointments. Since then, our ED and most others have resorted to more active linkage to care methods, which include partnerships with case management, social work, and on-site specialty care clinics, often involving patients' being taken directly from the ED to their first intake visit.[46,47] Such programs, as did ours, have yielded significant improvements in linkage to care, with ours achieving more than 90% success. The proportion of patients linked to care from various community settings (including sexually transmitted diseases clinics, primary

care clinics, community-based organizations, health departments, homeless shelters, single-room-occupancy hotels, and other unspecified community HIV testing settings) was reported in that same meta-analysis to be significantly lower (69%) than that observed in EDs and urgent care settings.[30] Investigators who conducted the meta-analysis study speculated that the availability of on-site HIV clinics within the same institution was the primary driver for that improved outcome. If their conjecture is true, EDs might well be optimally positioned to help narrow this critical gap in the national HIV Care Continuum. Providing the appropriate follow-up and linkage to care for urgent conditions is in fact in keeping with one of the primary roles EDs play for all of our patients.

In addition to effectively linking patients with newly diagnosed HIV infection to care, EDs could play a role in relinking known HIV-positive patients to care, including those who were never in care, as well as those who ceased care. The potential value of that intervention was first proposed by Lyons et al,[38] who demonstrated both patient acceptability and feasibility (albeit when supplementary resources were used) for such an intervention. Conceptually, EDs could leverage fixed infrastructure put in place for linking to care patients with newly diagnosed HIV (eg, use of case managers, streamlined referral methods), permitting sustainable programs for relinking or promoting retention in care for those with known HIV infection. Again, however, the value and cost of offering those services need to be carefully evaluated within the framework of the ED mission.

For the HIV Care Continuum, we propose consideration of 3 new stages that are particularly relevant for ED populations in this study, namely, provider awareness of HIV diagnosis, patient receiving antiretroviral treatment—patient self-aware, and viral load suppression—patient self-aware. Provider awareness of HIV diagnosis is well recognized to be important for ED clinical management decisions and has been previously reported to affect clinical decisionmaking.[48,49] Patient self-awareness of receiving antiretroviral therapy may be relevant for ED management decisions (including referral for treatment, potential medication-related complications, or contraindications for medications prescribed in the ED). Patients' self-awareness about whether they are virally suppressed may be critical for forming appropriate differentials according to their ED presenting complaint. Furthermore, because antiretroviral treatment is now recommended for all HIV-positive individuals, regardless of CD4 count (both for reducing risk of disease progression and prevention of transmission of HIV in the community),[50,51] patient awareness of viral suppression status could help clinicians optimize timing of linkage to care as appropriate. From a public health standpoint, introducing the concept of patient self-awareness about viral suppression status could be a marker for slowing community transmission (similar to what was previously found in regard to patient self-awareness of HIV serostatus),[52] though further investigation would be required. Finally, these additional proposed "awareness" stages along the HIV Care Continuum could serve as targets for HIV surveillance efforts, as well as assessment tools for intervention programs.

Finally, the HIV Care Continuum framework provides a potential model for discussion about the role EDs play in the management of other treatable chronic diseases. There is a wide variety of underdiagnosed or untreated indolent chronic diseases among the ED population (eg, hypertension, diabetics, hepatitis C, depression) in which advancing a disease-specific care continuum model could yield improved outcomes, were effective holistic strategies to be considered. Advancement of the HIV Care Continuum grew out of the sometimes fragmented care that emerged with evolving epidemic and treatment strategies—many of which remain untapped, as highlighted by the numerous gaps that remain—providing opportunities for improved care of this population.[4] Regardless of whether EDs engage in taking on the challenge of the gaps in the continuum of care, consideration of the framework for clinical and public health outcomes is relevant to the emergency medicine community.

In conclusion, to our knowledge this study represents the first introduction of the HIV Care Continuum framework to emergency medicine professionals and provides a set of estimates for the gaps in the care continuum from an ED patient population perspective. Our findings highlight the presence of multiple potential missed opportunities along the continuum of HIV care for ED patients but leave questions about how the ED or others can effectively manage these gaps.

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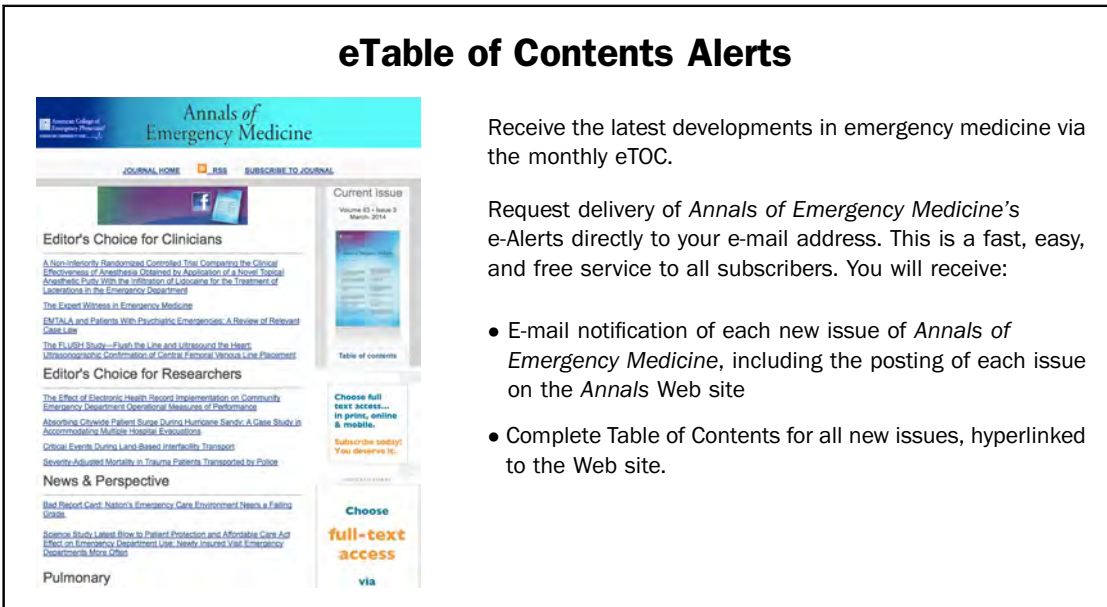
performed statistical analysis. Y-HH drafted the article, and all authors contributed substantially to its revision. Y-HH takes responsibility for the paper as a whole.

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