Health Information Exchange: A Novel Re-linkage Intervention in an Urban Health System

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Background. Public health information exchanges (HIEs) link real-time surveillance and clinical data and can help to re-engage out-of-care people with HIV (PWH).

Methods. We conducted a retrospective cohort study of out-of-care PWH who generated an HIE alert in the Grady Health System (GHS) Emergency Department (ED) between January 2017 and February 2018. Alerts were generated for PWH who registered in the GHS ED without Georgia Department of Public Health (GDPH) CD4 or HIV-1 RNA in the prior 14 months. The alert triggered a social work (SW)–led re-linkage effort. Multivariate logistic regression analyses used HIE-informed SW re-linkage efforts as the independent variable, and linkage to care and 3- and 6-month viral suppression (HIV-1 RNA < 200 c/mL) as primary outcomes. Patients admitted to the hospital were excluded from primary analysis.

Results. One hundred forty-seven out-of-care patients generated an alert. Ninety-eight were included in the primary analysis (mean age [SD], 41 ± 12 years; 70% male; 93% African American), and 20 received the HIE-informed SW intervention. Sixty percent of patients receiving the intervention linked to care in 6 months, compared with 35% who did not. Patients receiving the intervention were more likely to link to care (adjusted risk ratio [aRR], 1.63; 95% confidence interval [CI], 0.99–2.68) and no more likely to achieve viral suppression (aRR, 1.49; 95% CI, 0.50–4.46) than those who did not receive the intervention.

Conclusions. An HIE-informed, SW-led intervention systematically identified out-of-care PWH and may increase linkage to care for this important population. HIEs create an opportunity to intervene with linkage and retention strategies.

Keywords. implementation science; linkage to care; health information exchange; viral suppression; care continuum; information sharing.

Advances in HIV treatment transformed HIV infection from an almost certain death sentence into a manageable chronic condition [1]. To realize these benefits, patients must actively and continuously engage in outpatient HIV treatment for their entire lives. Over 50% of people with HIV (PWH) are not retained in HIV care, increasing the risk of disease progression, death, and virus transmission [2, 3]. Additionally, 22% of individuals newly diagnosed with HIV do not link to care within 1 month [4]. Considering that 60% of new HIV infections occur from those who are previously diagnosed but not retained in care [5, 6], interventions targeting these populations are of critical importance in improving receipt of regular care, achieving viral

suppression, and preventing HIV transmission. The population of diagnosed but poorly retained patients may face a number of barriers to (re)-linkage to care, including lack of insurance, poor access to health care, housing instability, stigma, transportation difficulties, denial of diagnosis, or comorbidities such as substance use or mental illness [7, 8]. Due to these barriers, traditional linkage and re-linkage efforts have failed to reach this population. Therefore, novel interventions are needed to engage this important population in care.

Linkage to care is especially important in the Southern United States, which is the epicenter of the domestic HIV epidemic. The Southern region accounts for 52% of new HIV diagnoses and 47% of deaths attributable to HIV/AIDS yet only 38% of the nation's population. Georgia is the state with the highest rate of new HIV diagnoses in the country, at 24.9/100 000 people [9]. Additionally, individuals newly diagnosed in the Southern United States are more likely to delay initiating ART and are more likely to experience complications from HIV [10, 11]. HIV care engagement is worse in the South, and re-linkage and retention interventions are especially important in this region.

Despite poor engagement in HIV-related medical care, PWH continue to access the health care system at large, particularly the emergency department (ED) [12]. Often these visits are not for HIV-related medical conditions, and the medical provider may remain unaware that the patient has HIV infection and is out of care. These visits represent an opportunity for more robust re-engagement efforts. A public health information exchange (HIE) leverages data traditionally collected only for surveillance to impact direct patient care. Applied to HIV care, HIEs can assist health care providers and social workers in identifying PWH who are out of care and accessing the health care system for unrelated reasons [13, 14]. The Louisiana Public Health Information Exchange (LaPHIE) relied on direct provider notification that their patient was living with HIV and out of care. Program analysis found that 85% of patients generating an alert had at least 1 subsequent CD4 or HIV-1 RNA, a surrogate for a high level of linkage to care [15]. In view of this model, the Grady Health System (GHS) implemented a tailored version of the HIE model in partnership with the Georgia Department of Public Health (GDPH) [16, 17]. The Georgia Public Health Information Exchange (GPHIE) utilizes GHS social workers to provide linkage resources and motivation to out-of-care patients who present to the GHS ED. Previous studies have demonstrated that brief case management interventions improve linkage to care, whereas enhanced personal contact improves patient retention once engaged in care [18, 19]. However, no studies have combined HIE-based notification with a social worker–led intervention, and no studies have looked into HIEs implemented exclusively in the ED environment. We report the outcomes from an HIE re-linkage intervention in a large urban health system in the Southern United States.

METHODS

Study Design

Health Information Exchange Intervention

The GPHIE is a bidirectional health information–sharing platform between the GDPH and the GHS that utilizes data traditionally collected for surveillance in the delivery of patient care. All CD4 and HIV-1 RNA results for Georgia residents are reportable by laboratories to GDPH and uploaded to the Georgia HIV Surveillance database. An out-of-care watch list that includes all persons diagnosed with HIV and reported to GDPH who had no CD4 or HIV-1 RNA tests during the last 14 months is updated regularly and matched against patient registrations in GHS in real time. The 14-month interval was selected to minimize the number of patients falsely identified as being out of care due to delays in data reporting, maximizing the specificity of the alert. An HIE alert is automatically generated when a match occurs between a patient registration message and the out-of-care watch list. Based on Georgia Law, the GPHIE alert must be sent to a physician provider. At GHS, the alert is sent

to 2 clinicians, who then notify 1 of 2 ED social workers (SWs). These SWs are specifically trained in motivational interviewing and have significant experience working with PWH. The SWs approach the patient, explain the GPHIE system, and ascertain if the patient is engaged in HIV care. If not, the SW educates the patient, assesses barriers to care, and offers re-linkage support, either to the prior site of care or the Grady HIV clinic, known as the Infectious Disease Program (IDP). Patients are able to walk into the IDP to initiate enrollment and see a prescribing physician within 72 hours without an appointment. The SW then facilitates a warm handoff to the IDP health educator or another clinic. Depending on patient preferences, the SW will follow up with reminder calls. SWs only respond to HIE alerts Monday through Friday, 9:00 AM to 5:00 PM. Patients who generate alerts overnight or on weekends do not receive the SW intervention and cannot be initially contacted after they leave the ED for institutional restrictions. However if the electronic medical record (EMR) indicates the patient was previously seen at IDP, the SW will notify the IDP Health Educator who has jurisdiction to then pursue re-linkage interventions. This IDP health educator intervention was not standardized but generally involved calling the patient, discussing their recent ED visit and reasons for being out of care, encouraging them to return to clinic and attempting to solve any barriers such as transportation or paperwork. Importantly this intervention differed from the HIE SW intervention in that it was not in person and did not occur at the time of contact with the health care system.

Setting

The study was conducted within GHS in Atlanta, Georgia. Patients newly diagnosed with HIV at GHS are 77% male, 72% black/non-Hispanic, 77% uninsured, and 66% have AIDS at the time of diagnosis [20]. The majority of ambulatory HIV care within the GHS is provided at IDP, a Ryan White HIV/AIDS Program–funded clinic. The IDP is the largest HIV care provider in Georgia with over 6200 active patients.

Patients

All patients ≥18 years of age who generated an HIE alert between January 1, 2017, and January 31, 2018, were assessed for study inclusion. Patients who self-reported as currently in care were excluded as they did not represent the study population of out-of-care patients. Patients who were admitted to the hospital were excluded from the primary analysis because these patients received an intensive inpatient SW linkage intervention during admission and upon discharge regardless of the HIE alert, obscuring the effect of the relatively brief ED SW contact.

Data Collection and Definitions

Patient demographics, sociobehavioral characteristics, HIV diagnosis and treatment history, hospitalizations, clinic visits, and laboratory data (CD4 and HIV-1 RNA) were collected from the

GHS electronic health record through July 31, 2018. The clinical encounters, notes, and labs from the prior 3 years were individually reviewed, and the EMR search feature was used to search for key terms such as "homeless," "unstable housing," "shelter," "substance use," and "employment." In addition, diagnosis date, pre-alert HIV-1 RNA and CD4 values, and post-alert HIV-1 RNA and CD4 values were collected from the GDPH surveillance database accounting for patients who received treatment or linked to care outside GHS.

Unstable housing was defined as any indication in the EMR of homelessness or living in a shelter within the last 2 years based on provider or SW notes. Substance use was defined as any documented use of cocaine, amphetamines, or opiates in the notes or on urine drug screens or alcohol use >2 drinks per day for men or >1 drink per for women in the last 2 years in the provider notes. Unemployment was defined as any documentation of unemployment within the Grady EMR in the last 2 years. Previous HIV care was defined as >1 visit with an HIV provider at GHS at any point before HIE alert generation.

The control group was defined as the group of patients who generated an HIE alert but who were not contacted by the HIE SW in the ED or admitted to the hospital. Linkage to care was defined as any visit with an HIV provider within GHS and/or any CD4 or HIV RNA result within the GDPH database during the 6-month follow-up period. GHS linkage, specifically, was defined as a known visit with a provider at IDP. Viral suppression was defined as achieving an HIV RNA <200 copies/mL during the 6-month follow-up window in the GHS or GDPH database.

Statistical Analysis

Descriptive statistics were used to characterize the out-of-care and not admitted population overall and by SW intervention status (intervention, control). Distributions of continuous variables by SW intervention status were compared by t test or Wilcoxon rank-sum test as appropriate. Distributions of categorical variables by SW intervention status were compared by chi-square test or Fisher exact test as appropriate. Separate logistic regression models assessed achievement of the primary outcomes (6-month linkage to care and viral suppression) by SW intervention status, adjusting for age, gender, race/ethnicity, homelessness, substance use, and history of antiretroviral treatment. Model fit was assessed with Hosmer-Lemeshow and c-statistic. A secondary analysis among all out-of-care patients evaluated the linear association of degree of SW intervention with each of the following outcomes: linkage to care in 6 months, viral suppression in 3 months, and viral suppression in 6 months. A decision was made a priori for the primary analyses to exclude hospitalized patients. A post hoc secondary analysis included the hospitalized population in a dose–response (SW) evaluation. The Emory Institutional Review Board (IRB 00087151), GDPH Institutional Review Board, and Grady Research Oversight Committee approved the study.

RESULTS

Patient Characteristics

Between 1/1/17 and 1/31/18, 166 patients generated an HIE alert in the GHS ED. Eighteen patients (11%) self-reported being engaged in care. One patient was known to be HIV negative and thus represented an erroneous alert. Thus, 147 out-of-care PWH generated an alert; these individuals represent our study population. Forty-four (27%) patients were admitted from the ED and received an intensive inpatient SW intervention, and 3 (2%) had a subsequent hospital admission within the 6-month follow-up period. The remaining 98 patients were included in the primary analysis (Figure 1). Of these 98 patients, 20 (20%) received the ED SW re-linkage intervention. The remaining 78 patients represent the control group of patients who generated an alert but did not interact with an ED SW. Of these 78 patients, 18 had their information sent to a Health Educator at IDP to attempt re-linkage.

Table 1 describes the population characteristics overall and by SW intervention. The majority of patients were male (70%) and African American (93%). Thirty percent were unstably housed, 58% unemployed, and 54% uninsured. Twenty-nine percent of patients had been incarcerated within the last year, and 37% had a history of substance use. Twenty-five percent had a psychiatric diagnosis documented within the EMR. Thirty-five patients (35%) had subsequent ER visits within 6 months. There was no difference in these variables between the intervention and control groups.

As outlined in Table 2, the average time since diagnosis with HIV was 9.1 ± 6.7 years. Thirty percent of patients had no prior documentation of their HIV status within the GHS EMR, whereas 31% were previously engaged in care within the GHS. Fifty-one percent of patients were engaged in HIV treatment within the GHS in the past, and 31% achieved viral suppression before disengaging from care, as documented in the GHS electronic health record (EHR) or GDPH records.

Outcome Data

Of 98 patients generating an alert, 20 received the SW intervention. Of those 20 patients, 12 (60%) linked to care within 6 months (5 [25%] within 30 days) and 4 (20%) achieved viral suppression, whereas of those who did not receive the SW intervention, only 27 (35%) linked to care (8 [10%] within 30 days) and 10 (13%) achieved viral suppression.

After controlling for age, gender, race, drug use, homelessness, and prior HIV treatment, patients who received the SW intervention had an adjusted risk ratio for linkage to care within 6 months of 1.63 (95% CI, 0.99–2.68) and an adjusted risk ratio for viral suppression within 6 months of 1.49 (95% CI, 0.50–4.46) compared with those who did not receive the intervention (Table 3).

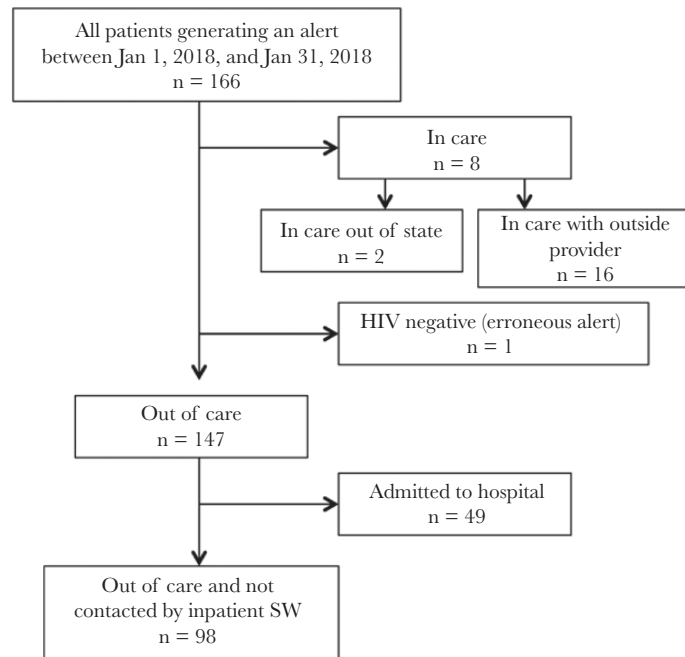Of the 98 patients generating an alert, 40% linked to care and 14% achieved viral suppression within 6 months. When

Figure 1. Exclusion criteria. Abbreviation: SW, social worker.

stratified by degree of intervention, 67% of admitted patients, 60% of those who received the inpatient SW intervention, 50% of those whose information was sent to IDP, and 30% of patients receiving no intervention were linked to care within 6 months of alert generation. Likewise, 39% of admitted patients, 20% of patients receiving the SW intervention, 11% of patients whose information was sent to IDP, and 13% of patients receiving no intervention achieved viral suppression within 6 months (Figure 2).

DISCUSSION

Over the course of 13 months, 166 HIE alerts were generated at registration in an urban ED, and 147 of those alerts represented out-of-care PWH. Twenty of these individuals were approached in the ED and received a tailored linkage intervention by a social worker. After multivariate analyses, patients who received the SW intervention were 63% more likely to be linked to HIV care within 6 months of visiting the ED. Although bordering on statistical significance at the $P < .05$ cutoff, the sample is small,

Table 1.   Patient Demographics (n = 98)

Characteristic	Total (n = 98)	SW Intervention		P Value
		No (n = 78)	Yes (n = 20)	
Basic demographic				
Age, mean ± SD, y	41.0 ± 12.3	40.8 ± 12.4	41.9 ± 12.2	.7185
Birth sex, male, No. (%)	69 (70)	55 (71)	14 (70)	.9642
Race/ethnicity, No. (%)				
African American	91 (93)	72 (92)	19 (95)	1.0000
Non–African American	6 (6)	5 (6)	1 (5)	
Socioeconomic education, No. (%)				
Less than HS/GED	5 (5)	4 (5)	1 (5)	1.0000
HS/GED or higher	15 (15)	13 (17)	2 (10)	
Unstably housed, No. (%)	29 (30)	23 (29)	6 (30)	.9818
Unemployed, No. (%)	57 (58)	48 (62)	9 (45)	.1413
Substance use, No. (%)	36 (37)	28 (36)	8 (40)	.6723
Payer source, No. (%)				
Private	8 (8)	7 (9)	1 (5)	.8272
Medicaid/Medicare	36 (37)	28 (36)	8 (40)	
None	53 (54)	42 (54)	11 (55)	

Abbreviations: GED, general education development; HS, high school; SW, social worker.

Table 2.   HIV Infection History

Characteristic	Total (n = 98)	SW Intervention No (n = 78)	SW Intervention Yes (n = 20)	P Value
Diagnosis				
Years since HIV diagnosis, mean ± SD	9.1 ± 6.7	8.9 ± 7.0	10.1 ± 5.5	.4674
HIV status				
Documentation of HIV status in GHS chart before alert, No. (%)	69 (70)	53 (68)	16 (80)	.2922
Treatment history				
Ever in care within GHS, No. (%)	50 (51)	36 (46)	14 (70)	.1353
Ever virologically suppressed before alert, No. (%)	30 (31)	23 (30)	7 (35)	.6332
CD4 nadir in the 2 y before alert, median (IQR), cells/µL	185 (325)	232 (334)	116 (254)	.1756
CD4 nadir <200 cells/µL, No. (%)	36 (37)	24 (31)	12 (60)	.1066
Condition before alert				
Last HIV-1 RNA before alert, median (IQR), copies/mL	89.1 (4571)	303.7 (4231)	39.8 (58 884)	.8293
Last HIV-1 RNA before alert, median (IQR), $\log_{10}$ copies/mL	2.0 (3.7)	2.7 (3.7)	1.6 (4.8)	.8020
Last CD4 before alert, mean (SD), cells/µL	395.8 ± 236.6	408.1 ± 231.3	347.5 ± 262.3	.4533
Years between last HIV-1 RNA/CD4 and alert, median (IQR)	2.3 (1.7)	2.3 (2.0)	1.7 (1.2)	.1560
Condition at alert				
HIV-1 RNA, median (IQR), copies/mL	23 947.5 (87 313)	89 555.4 (222 348)	5624.1 (17 235)	.0927
HIV-1 RNA, median (IQR), $\log_{10}$ copies/mL	4.4 (1.4)	4.9 (0.9)	3.7 (1.0)	.0927
CD4, median (IQR), cells/µL	257.0 (332.0)	82.0 (335.0)	294.0 (177.0)	.1394

Data are from GHS and GDPH unless specifically stated to be only from GHS.

Abbreviations: GDPH, Georgia Department of Public Health; GHS, Grady Health System; IQR, interquartile range; SW, social worker.

and the potential effect size of this finding warrants further investigation in appropriately powered studies. The GHS-GPDH HIE represents a novel intervention that successfully identified and linked out-of-care individuals living with HIV to care in the urban Southern United States. Our program is the first to report that HIEs can successfully increase linkage to care when

Table 3.   Adjusted Relative Risks of Successful Linkage to HIV Care Within 6 Months and Viral Suppression Within 6 Months by SW Intervention and Selected Characteristics

	Linkage to Care Adjusted Relative Risk (95% Confidence Interval)	P Value	Viral Suppression Adjusted Relative Risk (95% Confidence Interval)	P Value
HIE SW contact				
Yes	1.63 (0.99–2.68)	.0545	1.49 (0.50–4.46)	.4719
No	Ref			
Age, y				
18–25	1.39 (0.58– 3.34)	.4598	1.38 (0.30–6.38)	.6833
26–39	1.03 (0.56–1.88)	.9213	0.55 (0.17–1.78)	.3212
≥40	Ref		Ref	
Gender				
Male	1.00 (0.56–1.78)	.9906	0.65 (0.23– 1.87)	.4256
Female	Ref		Ref	
Race/ethnicity				
Non–African American	0.87 (0.27–2.77)	.809	NI	
African American	Ref			
Drug use				
Yes	0.85 (0.45–1.62)	.6187	0.97 (0.34–2.75)	.9498
No	Ref		Ref	
Homeless				
Yes	1.65 (0.91–2.96)	.0966	0.62 (0.20–1.98)	.4228
No	Ref		Ref	
History of HIV treatment				
Yes	1.42 (0.78–2.57)	.2491	0.93 (0.32–2.73)	.9023
No	Ref		Ref	

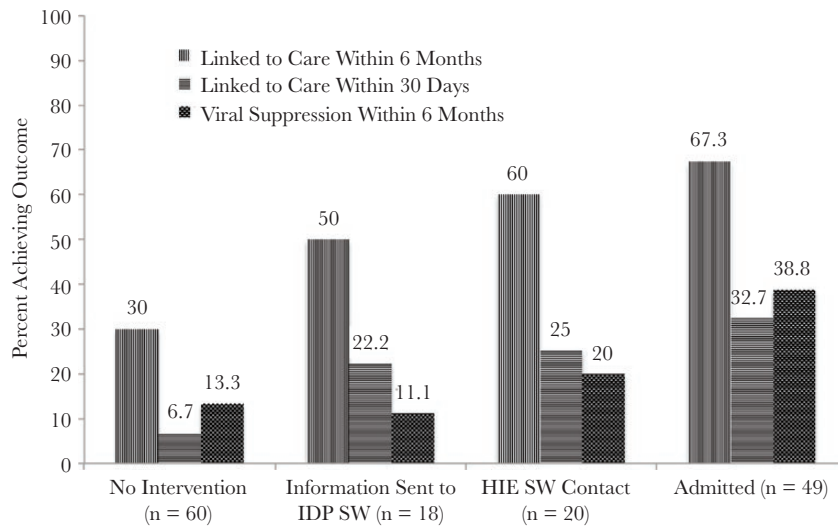Abbreviations: HIE, health information exchange; NI, not included; SW, social worker.

Figure 2. Rates of linkage and viral suppression by degree of intervention. Abbreviations: HIE, health information exchange; IDP, Infectious Disease Program; SW, social worker.

implemented in combination with an SW-led intervention in an urban ED. This differs from the LaPHIE program, where alerts were sent directly to the treating clinician, which was not feasible for technical reasons in the GPHIE [11–13].

This HIE-informed intervention represents a novel strategy to re-link PWH to care. Traditionally, linkage interventions have targeted patients identified by an HIV test. Among newly diagnosed patients, 78% link within 1 month [4]. Systematic attempts at linkage for those who have disengaged from care or do not link initially are often lacking. Although PLWH may have frequent interaction with health care systems, without a mechanism in place to identify those with an HIV diagnosis, acute care clinicians often do not know the HIV status of the patient unless testing is offered or the patient volunteers the information. In the population studied at GHS, 30% of patients had no documentation of HIV status in the EMR and an additional 31% were previously engaged in care at GHS, but even prior care in the same system can be missed in the busy acute care setting. By sharing information traditionally collected for surveillance with health care providers, the HIE intervention successfully targets a population that may be overlooked by traditional linkage or re-linkage interventions.

It is important to note that linkage-to-care interventions exist on a spectrum. Although we separated patients who received the SW intervention from those who did not, the patients could be further broken down into 4 categories representing progressively increased linkage support. The first group received no intervention, the second group had their information sent to a patient navigator at IDP (outpatient HIV clinic) by the ED SW for intervention, a third group received the intervention from the ED SW, and a fourth group was admitted to the hospital and received intensive, multiday inpatient SW

support, including working with a linkage coordinator affiliated with the outpatient HIV clinic. Although the groups were too small for analysis, there was a trend suggesting increased linkage to care and viral suppression as the intensity of the intervention increased. Of note, 35% of patients generating an HIE alert were admitted to the hospital, compared with an average admission rate of 22% at Grady in 2017. This higher rate of hospital admission likely reflects the clinical acuity of patients generating HIE alerts, and this too has been associated in the past with linkage to care [21]. As a whole, this trend suggests that more intensive linkage interventions may lead to improved linkage outcomes.

Disparities in linkage, retention, and viral suppression outcomes persist for African Americans and individuals with a history of unstable housing or substance use [6, 22–24]. PWH who are experiencing homelessness or unstable housing are known to access acute care settings such as EDs at a higher rate [25]. Thus, the population identified through HIE is a group in need of targeted interventions to improve care continuum outcomes. Specific interventions targeting these populations are particularly important to improving HIV outcomes as a whole [26]. By identifying these patients for linkage interventions, the HIE provides a platform on which to implement targeted interventions for linkage to HIV care or other social services.

Models such as the LaPHIE, which directly inform providers through the EMR, offer logistical benefits; however, some providers may feel uncomfortable discussing engagement with HIV treatment or may defer the discussion due to competing clinical responsibilities. Models such as the GPHIE, which rely on SWs trained in HIV disclosure and counseling, may offer a more effective intervention; however, they are limited by SW availability and by relying on the physician conduit. These

barriers could be overcome by directly routing alerts to SWs and by increasing funding for SW support.

Strengths and Limitations

The strengths of this study include evaluation of a novel intervention and its direct comparison with a similar group of out-of-care patients, all of whom generated an HIE alert. Additionally, the design accounts for linkage outside of the GHS by matching of databases with GPDH, and indeed, 70% of patients who linked to care within 6 months linked outside of the GHS.

The primary limitation of this study is the small sample size. This is especially evident with the wide confidence interval for viral suppression given few occurrences. Additionally, the retrospective, nonrandomized nature of the study only allows for conclusions around association. Because SWs were only available during business hours, it is possible that unmeasured variables affected both whether a patient received the SW intervention and whether they linked to care. Outcome data were further affected by the definition of linkage, which included patients with any CD4 HIV-1 RNA labs in the DPH system. It is possible that patients had HIV labs drawn outside of an HIV clinic visit (eg, emergency room or an outside hospital admission), and these labs therefore did not represent linkage to outpatient HIV care. Finally, patients who had their clinical information sent to a health educator at IDP were included in the control group because they did not have a face-to-face discussion with the HIE SW. Therefore, any increase in linkage that these patients experienced would have served to dampen the effect size of the intervention. The demographic data may underestimate certain factors such as homelessness and substance use because many patients only visited the ED and never linked to care within the GHS, and thus some charts did not include complete sociodemographic information.

There were many challenges to implementation of the HIE in our clinical context. Because the HIE was initially implemented across multiple health care systems with different EMRs, the alerts were not sent directly through the EMR, differentiating the GPHIE from LaPHIE. Additionally, Georgia law requires health information to be sent to health care providers, preventing alerts from being sent to SWs directly and thus delaying interventions. SWs were only available during normal business hours, and private face-to-face meetings were difficult to arrange around patient care in a busy ED, resulting in only 20% of alerts being acted upon. Finally, institutional rules restrict SWs from contacting patients after leaving the ED if the SW did not meet the patient in person, limiting the opportunity to engage the 80% of patients not contacted before leaving the ED.

CONCLUSIONS

In conclusion, HIEs successfully identify out-of-care PWH and provide an opportunity for real-time, (re)linkage to care interventions and programs. These results further suggest that an HIE-informed, SW-driven intervention may improve outcomes for out of-care patients who receive linkage support in the ED. Further research with controlled trials is needed to directly assess the impact of an HIE intervention, while implementation science will be critical to ensure uptake of successful interventions built around the HIE model.

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