Improving the Delivery of Chronic Opioid Therapy Among People Living With Human Immunodeficiency Virus: A Cluster Randomized Clinical Trial

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Background. Chronic pain is prevalent among people living with human immunodeficiency virus (PLWH); managing pain with chronic opioid therapy (COT) is common. Human immunodeficiency virus (HIV) providers often diverge from prescribing guidelines.

Methods. This 2-arm, unblinded, cluster-randomized clinical trial assessed whether the Targeting Effective Analgesia in Clinics for HIV (TEACH) intervention improves guideline-concordant care compared to usual care for PLWH on COT. The trial was implemented from 2015 to 2018 with 12-month follow-up at safety-net hospital-based HIV clinics in Boston and Atlanta. We enrolled 41 providers and their 187 patients on COT. Prescribers were randomized 1:1 to either a 12-month intervention consisting of a nurse care manager with an interactive electronic registry, opioid education, academic detailing, and access to addiction specialists or a control condition consisting of usual care. Two primary outcomes were assessed through electronic medical records: ≥ 2 urine drug tests and any early COT refills by 12 months. Other outcomes included possible adverse consequences.

Results. At 12 months, the TEACH intervention arm had higher odds of ≥ 2 urine drug tests than the usual care arm (71% vs 20%; adjusted odds ratio [AOR], 13.38 [95% confidence interval {CI}, 5.85–30.60]; $P < .0001$). We did not detect a statistically significant difference in early refills (22% vs 30%; AOR, 0.55 [95% CI, .26–1.15]; $P = .11$), pain severity (6.30 vs 5.76; adjusted mean difference, 0.10 [95% CI, –1.56 to 1.75]; $P = .91$), or HIV viral load suppression (86.9% vs 82.1%; AOR, 1.21 [95% CI, .47–3.09]; $P = .69$).

Conclusions. TEACH is a promising intervention to improve adherence to COT guidelines without evident adverse consequences.

Clinical Trials Registration. NCT02564341.

Keywords. HIV; chronic pain; chronic opioid therapy; prescription opioid misuse; pain management.

The overprescribing of opioid medications has contributed to the current opioid overdose epidemic [1–5]. This crisis has compelled greater scrutiny of chronic opioid therapy (COT) for chronic pain [6, 7]. Prevalence estimates of chronic pain in people living with human immunodeficiency virus (PLWH) reported in the last 10 years range from 40% to 58% [8, 9]. Problematic prescription opioid use appears to be common among PLWH [10]. A 2019 study of PLWH receiving COT found that 43% had a high Current Opioid Misuse Measure (COMM) score,

suggestive of aberrant use [11, 12]. Thus, pain management is by necessity a major responsibility of physicians who treat PLWH.

Human immunodeficiency virus (HIV) providers have recently reported low confidence in their abilities to treat pain and low satisfaction in delivering pain management [13, 14]. Providers concerned about the potential for opioid misuse may underprescribe opioids to PLWH [15, 16]. Conversely, providers who prioritize engagement in care may prescribe opioids despite risk of misuse [13, 17–21].

Interventions are needed to improve HIV providers' quality of care regarding opioid prescribing to effectively treat pain and mitigate prescription opioid misuse. Guidelines for opioid prescribing encourage routine monitoring through urine drug tests (UDTs), pill counts, and prescription monitoring programs, as well as assessment for negative consequences such as misuse, diversion, and addiction [7, 21].

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Collaborative care interventions, which have potential to improve clinical practice, are multidisciplinary, high-contact, and patient-centered, previously tested in the treatment of chronic diseases [22–26]. Few interventions have been tested to improve opioid prescribing; none, to our knowledge, focus on PLWH [27–29]. Thus, we adapted a previously developed intervention to create the Targeting Effective Analgesia in Clinics for HIV (TEACH) intervention [30]. We conducted a cluster randomized clinical trial to assess whether TEACH, compared to usual care, improves guideline-concordant care for COT among HIV providers and to assess for unintended consequences (eg, pain severity, detectable viral load).

METHODS

Study Objective and Design

The TEACH collaborative care intervention trial assessed the following outcomes: (1) HIV providers' adherence to COT guidelines; (2) patient-level outcomes as a consequence of the exposure to the TEACH intervention; and (3) virologic control [31]. For HIV provider adherence to COT guidelines, the primary outcome was completion of ≥ 2 UDTs over 12 months. Secondary outcomes included completion of an opioid treatment agreement, routine use of the prescription monitoring program, and ≥ 3 primary care visits over 12 months. For patient-level consequences, the primary outcome was any early refills at 12 months. Secondary outcomes included pain severity and pain interference with activities of daily living measured by the Brief Pain Inventory [32], discontinuation of opioid prescriptions, number of early refills, COMM scores ≥ 9 and ≥ 13 , past 30-day nonmedical opioid and stimulant use, and hazardous alcohol use (Alcohol Use Disorders Identification Test [AUDIT] score ≥ 8) [12, 33]. Exploratory outcomes concerning virologic control included HIV-1 RNA < 200 copies/mL at 12 months and CD4 cell count. The TEACH study protocol was described previously [31], registered with ClinicalTrials.gov (NCT02564341), and approved by the study sites' institutional review boards.

Provider and Patient Recruitment and Assessment

Recruitment

HIV physicians and advanced practice providers, henceforth referred to as "providers," were recruited from September 2015 through December 2016 from 2 safety-net hospital-affiliated HIV clinics in Boston and Atlanta (Figure 1). Provider inclusion criteria were (1) being a provider at the HIV clinics and (2) being the main prescriber for 1 or more PLWH receiving COT. Provider exclusion criteria included being a study investigator or planning to leave the clinic within 9 months. Providers' patients receiving COT, hereafter referred to as "patients," were enrolled simultaneously with their provider through a waiver of informed consent if the following eligibility criteria were met: (1) age ≥ 18 years; (2) diagnosis of HIV infection; (3) received COT defined as ≥ 3 opioid prescriptions ≥ 21 days apart within a 6-month period in the prior year; and (4) at least 1 HIV clinic

Figure 1. Consolidated Standards for Reporting Trials (CONSORT) diagram for the Targeting Effective Analgesia in Clinics for HIV (TEACH) intervention.

visit within the prior 18 months. The waiver of informed consent was pursued as it would not have been logistically possible to obtain informed consent from all patients on COT from a particular provider, and risk to patients was minimal.

Assessment

Providers completed baseline and 12-month follow-up assessments including demographics, training, and practices for assessing and treating pain, substance use, and managing prescribed opioids [31]. Compensation was a \$100 gift card upon each assessment completion. Data were extracted from the medical chart for providers' patients receiving COT.

Cohort Recruitment and Assessment

Recruitment

Additionally, patients were recruited into an observational cohort of PLWH receiving COT to assess secondary outcomes (eg, pain severity, substance use) from July 2015 through December 2016, hereafter referred to as "observational cohort participants." A research associate formally screened the patients and assessed additional eligibility criteria: (1) contact information of 2 individuals to assist with follow-up; (2) possession of a telephone; and (3) English speaking. Exclusion criteria included plans to move from the area within 12 months and inability to consent to interviews. Research staff obtained written informed consent.

Assessment

Observational cohort participants underwent 60- to 90-minute assessments by a research associate at baseline and 12 months [12, 31–36]. They were compensated with \$35 for baseline and \$50 for follow-up assessments.

Randomization

Providers were randomized to either the control group (ie, usual care) or the year-long TEACH intervention. Randomization was stratified by site and COT patient volume (1–2, 3–6, 7–11, and ≥ 12 eligible patients). To ensure balance with respect to the number of providers in each group, the permuted blocks strategy was used with an allocation ratio of 1:1 and blocks of 2. The random allocation sequence was generated by the study biostatistician and analyst, and was concealed until providers had completed the baseline assessment. Patients received the allocation assigned to their provider. Due to the nature of the intervention, neither providers nor research team were blinded to group assignment. Patients randomized to the intervention were informed that opioid monitoring procedures were being implemented in the clinic.

Control Condition

Providers in the control group received an informational brochure summarizing guidelines for COT and listing a web resource with electronic tools [31].

Intervention

The 12-month TEACH intervention consisted of 3 components: (1) a nurse care manager with an interactive electronic registry to manage patients; (2) opioid education and academic detailing; and (3) facilitated access to addiction specialists (Figure 2). TEACH was modeled on the TOPCARE (Transforming Opioid Prescribing in Primary Care) intervention, which is grounded in the Chronic Care Model for chronic disease management [29].

Didactic Session. Intervention providers received a 60-minute group didactic session from a study investigator expert on opioid prescribing, which consisted of developing communication

skills as well as reviewing resources outlining opioid prescribing guidelines [30].

Collaboration With Nurse Care Manager. Each site hired a nurse care manager (NCM) with a background in HIV care and interest in addiction. The NCMs collaborated closely with intervention providers to implement essential elements of guideline-driven care. They met with providers to review their COT patients. With provider assent, the NCMs conducted an initial intake assessment for each patient, which included the following: detailed medical, substance use, and social history; COMM score [12]; opioid risk tool [37]; and opioid treatment agreement. The NCM then followed up regularly with patients regarding refills, pain assessments, UDTs, and pill counts, the frequency being determined by patient risk level in collaboration with the provider. The NCM checked in with providers to discuss patient progress and challenges beyond the academic detailing sessions.

Interactive Electronic Registry. The NCM utilized a HIPAA (Health Insurance Portability and Accountability Act)–compliant, web-based registry specifically built using user-based design methods to record and generate individual or aggregate information in real-time reports on opioid treatment agreements, UDTs, pill counts and checking prescription monitoring programs [38]. The registry enabled the NCM to manage refills, assess risk for opioid misuse, tailor monitoring strategies, and document clinical interactions.

Academic Detailing. Providers participated in two 30-minute individual academic detailing sessions 2–3 months apart throughout the year-long intervention with an option of a third. At the sessions, providers received registry-generated reports on their COT patients to facilitate self-assessment of prescribing practices relative to patient risk levels [31]. Providers were encouraged to utilize academic detailing sessions to discuss challenging COT patients and develop treatment plans. These sessions helped providers develop effective communication to evaluate co-prescribed medications and to utilize monitoring tools such as UDTs.

Facilitated Access to Addiction Specialist. The NCM encouraged and arranged referral of patients with active substance use disorders to addiction specialists affiliated with the HIV clinics. The study protocol did not specifically dictate how such patients were managed. The NCMs met separately with study team addiction specialists weekly to obtain input on challenging scenarios to be shared with providers.

STATISTICAL ANALYSIS

Descriptive statistics were calculated for provider-level and patient-level variables at baseline and 12-month follow-up by study arm. This study was conducted under the intention-to-treat

Figure 2. Diagram of the Targeting Effective Analgesia in Clinics for HIV (TEACH) intervention. Abbreviations: AD, academic detailing; COT, chronic opioid therapy; NCM, nurse care manager. *An electronic system was used to manage patients.

principle, including all randomized participants according to their assignment. Randomization and the intervention occurred at the provider level while the unit of observation was either the individual providers' patients receiving COT or the providers, depending on the outcome. The primary analysis evaluating the effect of the intervention on binary, patient-level outcomes used generalized estimating equation (GEE) logistic regression analyses to account for clustering by providers. The models used an exchangeable working correlation structure and results are reported based on robust empirical standard errors. The models included the randomization group as the main independent variable and also controlled for randomization stratification factors (ie, site and provider volume). Post hoc analyses were conducted using Poisson regression to estimate incidence rate ratios (IRRs). The secondary outcome, number of early refills, was analyzed using a GEE negative binomial regression model. The negative binomial model was selected instead of Poisson regression to allow for overdispersion in the data. We used multiple imputation (using 25 generated complete datasets) to account for the following missing outcome data: ≥ 2 UDTs ($n = 6$), any early refills ($n = 5$), ≥ 3 primary care visits ($n = 4$), opioid treatment agreement ($n = 7$), opioid discontinuation ($n = 7$), number of early refills ($n = 7$), CD4 cell count ($n = 16$), HIV viral load ($n = 18$), and self-reported outcomes ($n = 9$). Variables used for imputation of patient-level outcomes included gender, depressive symptoms (Center for Epidemiologic Studies Depression Scale [CES-D] ≥ 16 [39]), hazardous drinking (AUDIT score ≥ 8 [33]), any drug use, ethnicity (Hispanic: yes/no), randomization group, study site, provider patient volume stratification group, baseline value of the outcome, race (white, black, other/not available), and the continuous variables age, body mass index, CD4 cell count, HIV viral load, and Charlson comorbidity index [40]. For patient-level outcomes, data were imputed separately by provider and small clusters were combined in some cases due to computational issues. Variables used for imputation of provider-level outcomes included gender, years of practice in HIV care, patient volume stratification group, study site, randomization group, and baseline value of the outcome. Post hoc analyses stratified by study site were conducted for the primary outcomes.

A priori power calculations assumed a 2-sided test, with a significance level of .05. We anticipated that 35 total providers would be enrolled in the study, with an average of 5 eligible patients per provider for a total of 175 patients. We expected that the intraclass correlation coefficient (ICC) would be < 0.10 for the outcomes of interest, and conservatively assumed a value of 0.10. The calculated ICCs across all imputed datasets were ≤ 0.01 for both primary outcomes. Calculations were based on a χ^2 test with continuity correction, with estimates adjusted for clustering based on the inflation factor and assuming 10% loss to follow-up. We calculated that the study would provide 80% power to detect an absolute difference of 28% for the primary outcome ≥ 2 UDTs and an absolute difference of 27% for the

primary outcome any early refills. Analyses were conducted using SAS version 9.4 software (SAS Institute).

RESULTS

Provider Characteristics

Across both sites, 32 physicians and 9 advanced practice providers ($n = 41$) were eligible, and all chose to participate. Of these, 21 were randomized to the TEACH intervention and 20 to the control group (Table 1). We did not identify any important differences in provider characteristics across study arms. Providers' characteristics included a mean age of 46 years (standard deviation [SD], 11 years); 63% were female; 63% were white and 10% Hispanic. Among physicians, 16% (5/32) were buprenorphine waived. The mean number of patients per provider on COT was 5 (SD, 6); 85% had 1–6 patients on COT.

Patient Characteristics

Providers had a total of 187 patients receiving COT (Table 2). Intervention providers had 87 patients, control providers 100. We did not observe important differences in patient characteristics across study arms. Of the 187 patients, 117 were enrolled in the observational patient cohort, and 114 completed a baseline assessment. Of the 114, 58 were in the intervention arm and 56 in the control arm. Patient characteristics included mean age, 54 years (SD, 9 years); 28% were female; 28% were white and 8% Hispanic. Observational cohort participants had similar demographic characteristics to patients of randomized providers: mean age, 53 years (SD, 8 years); 34% female; and 23% white and 8% Hispanic.

RCT Outcomes

Provider Outcomes

The primary provider-level outcome was completion of ≥ 2 UDTs in the period between baseline and follow-up. Intervention patients had 13 times the odds of completion of ≥ 2 UDTs (71% vs 20%; adjusted odds ratio [AOR], 13.38 [95% confidence interval {CI}, 5.85–30.60]) compared to control patients (Table 3). For descriptive purposes, we note that the median (25th, 75th percentiles) for number of UDTs was 3 (1, 5) and 0 (0, 1) for the intervention and control groups, respectively. Post hoc analyses using Poisson regression resulted in an adjusted IRR of 4.76 (95% CI, 2.68–8.48) for having a UDT. The TEACH intervention had higher odds of having the secondary outcome, completion of a signed opioid treatment agreement (AOR, 61.50 [95% CI, 15.30–247.20]). No statistically significant difference was found between arms for routinely using the prescription monitoring program or having ≥ 3 primary care visits in the study year.

Patient Outcomes

The primary patient-level outcome was 1 or more early refill. We did not detect a statistically significant intervention effect on any early refills (22% vs 30%; AOR, 0.55 [95% CI, .26–1.15]) or number of early

Table 1. Baseline Provider Characteristics in the Targeting Effective Analgesia in Clinics for HIV (TEACH) Study, by Study Arm and Overall

Characteristic	Intervention Arm (n = 21)	Control Arm (n = 20)	Overall (N = 41)
Age, y, mean (SD)	45.0 (11.5)	46.1 (11.7)	45.5 (11.5)
Female, No. (%)	12 (57.1)	14 (70.0)	26 (63.4)
Race/ethnicity, No. (%)			
White	12 (57.1)	14 (70.0)	26 (63.4)
African American	2 (9.5)	2 (10.0)	4 (9.8)
Asian	4 (19.0)	3 (15.0)	7 (17.1)
>1 race	3 (14.3)	0 (0.0)	3 (7.3)
Other	0 (0.0)	1 (5.0)	1 (2.4)
Hispanic	2 (9.5)	2 (10.0)	4 (9.8)
Professional title, No. (%)			
MD	17 (81.0)	15 (75.0)	32 (78.0)
Advanced Practice Provider	4 (19.0)	5 (25.0)	9 (22.0)
Boston site, No. (%)	6 (28.6)	5 (25.0)	11 (26.8)
Buprenorphine waived, No. (%)			
Yes	2 (9.5)	3 (15.0)	5 (12.2)
No	15 (71.4)	12 (60.0)	27 (65.9)
Not a physician ^a	4 (19.0)	5 (25.0)	9 (22.0)
No. of patients on COT, mean (SD)	4.10 (4.12)	5.00 (6.69)	4.54 (5.47)
Patients on COT, No. (%)			
1–2	9 (42.9)	9 (45.0)	18 (43.9)
3–6	9 (42.9)	8 (40.0)	17 (41.5)
7–11	1 (4.8)	0 (0.0)	1 (2.4)
≥12	2 (9.5)	3 (15.0)	5 (12.2)

Abbreviations: COT, chronic opioid therapy; SD, standard deviation.

^aAt the time of the study, only physicians could obtain a waiver to prescribe buprenorphine.

refills (secondary). For descriptive purposes, we note that the median (25th, 75th percentiles) for number of early refills was 0 (0, 0) and 0 (0, 1) for the intervention and control groups, respectively. Post hoc analyses using Poisson regression resulted in an adjusted IRR of 0.64 (95% CI, .34–1.22). No significant differences between arms were found for the secondary outcomes: having a COMM score ≥ 9 or ≥ 13 ; pain sensitivity; pain interference; past 30-day opioid or stimulant use; hazardous alcohol use, or discontinuing opioids at 12-month follow-up.

Virologic Control

An exploratory outcome was the intervention's impact on virologic control among PLWH receiving COT. We found no significant differences in undetectable HIV viral load (<200 copies/mL) (86.9% vs 82.1%; AOR, 1.21 [95% CI, .47–3.09]) or mean CD4 count (569 vs 500 cells/ μ L; adjusted mean difference, 70.25 [95% CI, –46.76 to 187.25]).

In post hoc analyses stratified by site, conclusions for the primary outcome, completion of ≥ 2 UDTs, were consistent with the overall analysis (Atlanta: AOR, 12.77 [95% CI, 4.81–33.87]; Boston: AOR, 131.79 [95% CI, 10.09–1721.18]). For the outcome any early refills, the intervention appeared to result in reduced odds of having any early refills in Atlanta (AOR,

Table 2. Baseline Patient Characteristics in the Targeting Effective Analgesia in Clinics for HIV (TEACH) Study, by Study Arm and Overall

Characteristic	Intervention (n = 87)	Control (n = 100)	Overall (N = 187)
Age, y, mean (SD)	54.4 (8.0)	53.5 (9.2)	53.9 (8.7)
Female, No. (%)	25 (28.7)	28 (28.0)	53 (28.3)
Race/ethnicity, No. (%)			
White	26 (29.9)	27 (27.0)	53 (28.3)
Black	56 (64.4)	67 (67.0)	123 (65.8)
Other/not available	5 (5.7)	6 (6.0)	11 (5.9)
Hispanic, No. (%)	7 (8.0)	8 (8.0)	15 (8.0)
Sexual orientation ^a , No. (%)			
Straight/heterosexual	38 (65.5)	37 (66.1)	75 (65.8)
Gay/lesbian/queer/homosexual	14 (24.1)	16 (28.6)	30 (26.3)
Bisexual	5 (8.6)	3 (5.4)	8 (7.0)
Other	1 (1.7)	0 (0.0)	1 (0.9)
High school graduate ^a , No. (%)	37 (63.8)	39 (69.6)	76 (66.7)
Housing, No. (%) ^a			
Own or rent home/apartment	47 (81.0)	49 (87.5)	96 (84.2)
Staying at home of family member(s)	6 (10.3)	3 (5.4)	9 (7.9)
In a rooming, boarding, or halfway house	1 (1.7)	4 (7.1)	5 (4.4)
Other	4 (6.9)	0 (0.0)	4 (3.5)
Jail or prison (past 12 mo) ^a , No. (%)	4 (6.9)	6 (10.7)	10 (8.8)
HIV transmission route ^a , No. (%)			
MSM/IDU	3 (5.2)	3 (5.4)	6 (5.3)
MSM only	16 (27.6)	13 (23.2)	29 (25.4)
IDU only	6 (10.3)	5 (8.9)	11 (9.6)
Presumed heterosexual + blood/blood products	5 (8.6)	6 (10.7)	11 (9.6)
Presumed heterosexual only	28 (48.3)	29 (51.8)	57 (50.0)
Undetectable viral load, No. (%)	81 (95.3)	85 (86.7)	166 (90.7)
Ever injected drugs ^b , No. (%)	14 (24.6)	9 (18.8)	23 (21.9)

Abbreviations: HIV, human immunodeficiency virus; IDU, injection drug use; MSM, men who have sex with men; SD, standard deviation.

^aSubset of patients with n = 114 at baseline, n = 105 at follow-up.

^bOnly asked at follow-up.

0.34 [95% CI, .13–.89]) but not Boston (AOR, 4.03 [95% CI, .78–20.89]).

DISCUSSION

This cluster randomized clinical trial tested the TEACH intervention to improve opioid prescribing among providers treating PLWH on COT. Patients in the TEACH arm had a statistically significant improvement of 2 recommended features of appropriate care for patients on COT: completion of ≥ 2 UDTs and opioid treatment agreements.

Table 3. Targeting Effective Analgesia in Clinics for HIV (TEACH) Study Outcomes at 12 Months^a

Outcome	Intervention (n = 87)	Control (n = 100)	AOR (95% CI) ^b	P Value
Provider adherence to COT guidelines				
≥2 urine drug tests over 12 mo ^c	71.0%	19.9%	13.38 (5.85–30.60)	<.0001
≥3 primary care visits over 12 mo	80.2%	76.0%	1.33 (.63–2.84)	.45
Opioid treatment agreement	75.6%	12.8%	61.50 (15.30–247.20)	<.0001
Provider routinely consulted prescription monitoring program ^d	71.4%	45.0%	3.85 (.99–14.93)	.05
Patient-level outcomes				
≥1 early refill over 12 mo ^c	21.6%	30.4%	0.55 (.26–1.15)	.11
No. of early refills over 12 mo, mean (SD)	0.46 (1.00)	0.60 (1.14)	0.64 (.32–1.30) ^e	.21
COMM score ≥9 ^f	38.7%	39.9%	0.78 (.33–1.88)	.58
COMM score ≥13 ^f	27.6%	19.4%	1.68 (.59–4.77)	.33
Discontinuation of opioid prescriptions (MEDD of 0 in the 60 d prior to visit)	30.3%	25.6%	1.62 (.82–3.22)	.17
Pain severity (BPI), mean (SD) ^f	6.30 (2.87)	5.76 (2.87)	0.10 (–1.56 to 1.75) ^g	.91
Pain interference (BPI), mean (SD) ^f	5.70 (2.98)	4.99 (3.58)	0.30 (–1.34 to 1.95) ^g	.72
Past 30-d opioid/stimulant use ^{d,f}	7.5%	12.0%	0.65 (.15–2.79)	.57
Hazardous alcohol use (AUDIT score ≥8) ^f	17.9%	10.4%	1.03 (.21–5.02)	.97
HIV virologic control				
Undetectable viral load (<200 copies/mL)	86.9%	82.1%	1.21 (.47–3.09)	.69
CD4 count, cells/μL, mean (SD)	568.67 (357.43)	500.48 (316.21)	70.25 (–46.76 to 187.25) ^g	.24

Abbreviations: AOR, adjusted odds ratio; AUDIT, Alcohol Use Disorders Identification Test; BPI, Brief Pain Inventory; CI, confidence interval; COMM, Current Opioid Misuse Measure; COT, chronic opioid therapy; HIV, human immunodeficiency virus; MEDD, Morphine Equivalent Daily Dose; SD, standard deviation.

^aTable presents unadjusted proportions and means.

^bAdjusted for stratification variables site (Boston vs Atlanta) and patient volume (1–2, 3–6, 7–11, and ≥12 patients).

^cPrimary outcome bolded.

^dUnadjusted due to small numbers.

^eAdjusted incidence rate ratio.

^fSubset of patients, n = 114.

^gAdjusted mean difference between arms.

The TEACH intervention significantly improved adherence to CDC and HIV Medicine Association–recommended guidelines [6, 7, 21], and yet did not appear to worsen potential patient adverse unintended consequences: early refills, increased pain levels, more severe substance use, and COMM scores. Of note, we did not detect differences in discontinuation of opioids between groups. By creating a collaborative clinical role for a dedicated NCM, these challenging aspects of achieving guideline-concordant HIV clinical care for patients receiving COT were successfully implemented.

Adhering to CDC guidelines for opioid prescribing requires additional elements of care to be delivered to patients, and this added work can be overwhelming for providers to implement routinely [14]. However, team-based care of chronic pain with an embedded nurse care manager with explicit responsibilities related to COT management can augment safe opioid prescribing without adding major provider tasks. A potential concern regarding TEACH intervention implementation was that increased monitoring might result in adverse patient outcomes. This, however, was not observed among secondary outcomes or the exploratory outcomes of CD4 cell count or viral suppression.

Before this study was implemented, few initiatives to change COT prescribing practices were being implemented at the study sites. However, after the trial's completion, checking the prescription monitoring program became mandatory in Massachusetts and Georgia.

This study had limitations. Throughout the study period, national attention on the opioid epidemic increased. It is possible that providers in the control group were exposed to an anticipated level of attention regarding COT and consequently changed their prescribing practices. Such exposure might result in an underestimation of the effect of the TEACH intervention. However, given the marked differences in some outcomes, this is not a major limitation. Due to the lack of blinding, contamination of the control arm as a consequence of communication between enrolled providers may have occurred, which should bias toward the null. Not all patients receiving COT were enrolled in the observational patient cohort, potentially affecting power to detect differences in self-reported outcomes. While examining both Boston and Atlanta provided more generalizability than in a single-site study, they do not represent all HIV care in the United States.

In conclusion, the TEACH intervention was more effective than usual care in improving guideline concordant care for chronic opioid therapy, as measured by completion of ≥2 UDTs and opioid treatment agreements among PLWH. No significant differences were observed for early refills or viral suppression. The TEACH intervention is a promising strategy to address chronic opioid therapy in HIV care.

Notes

Author contributions. J. H. S., C. d. R., J. I. T., M. C. L., C. L. B., J. M. L., A. Y. W., and D. M. C. were responsible for the conception and design of the study. J. H. S., J. I. T., J. M. L., C. L. B., M. C. L., and C. W. S. were responsible

for the design of the intervention, and J. M. L., C. W. S., A. Y. W., M. M. S., J. A. C., M. C. L., C. R., K. O., and C. A. implemented the intervention. M. C. L., C. L. B., and C. R. coordinated study activities. K. O., and C. H. collected data, and D. M. C. and L. S. F. managed study data and analyses. J. H. S. and M. C. L. drafted the manuscript. All authors read, revised, and approved the final manuscript. J. H. S. had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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