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Buprenorphine Maintenance Treatment Retention Improves Nationally Recommended Preventive Primary Care Screenings when Integrated into Urban Federally Qualified Health Centers

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ABSTRACT *Buprenorphine maintenance therapy (BMT) expands treatment access for opioid dependence and can be integrated into primary health-care settings. Treating opioid dependence, however, should ideally improve other aspects of overall health, including preventive services. Therefore, we examined how BMT affects preventive health-care outcomes, specifically nine nationally recommended primary care quality health-care indicators (QHIs), within federally qualified health centers (FQHCs) from an observational cohort study of 266 opioid-dependent patients initiating BMT between 07/01/07 and 11/30/08 within Connecticut's largest FQHC network. Nine nationally recommended preventive QHIs were collected longitudinally from electronic health records, including screening for chronic infections, metabolic conditions, and cancer. A composite QHI score (QHI-S), based on the percentage of eligible QHIs achieved, was categorized as QHI-S ≥80 % (recommended) and ≥90 % (optimal). The proportion of subjects achieving a composite QHI-S ≥80 and ≥90 % was 57.1 and 28.6 %, respectively. Screening was highest for hypertension (91.0 %), hepatitis C (80.1 %), hepatitis B (76.3 %), human immunodeficiency virus (71.4 %), and hyperlipidemia (72.9 %) and lower for syphilis (49.3 %) and cervical (58.5 %), breast (44.4 %), and colorectal (48.7 %) cancer. Achieving QHI-S ≥80 % was positively and independently associated with ≥3-month BMT retention (adjusted odds ratio (AOR)=2.19; 95 % confidence interval (CI)=1.18–4.04) and BMT prescription by primary care providers (PCPs) rather than addiction psychiatric specialists (AOR=3.38; 95 % CI=1.78–6.37), and negatively with being female (AOR=0.30; 95 % CI=0.16–0.55). Within primary health-care settings, achieving greater nationally recommended health-care screenings or QHIs was associated with being able to successfully retain patients on buprenorphine longer (3 months or more) and when buprenorphine was prescribed simultaneously by PCPs rather than psychiatric specialists. Decreased preventive screening for opioid-dependent women, however, may require gender-based strategies for achieving health-care parity. When patients can be retained, integrating BMT into urban FQHCs is associated with improved health outcomes including increased multiple preventive health-care screenings.*

KEYWORDS *Buprenorphine, Integrated care, Substance abuse, Addiction, Opioid dependence, Health-care utilization, Quality health-care indicators, Preventive screening, Primary care, Federally qualified health centers, Implementation science, Health disparities, Women*

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INTRODUCTION

Opioid dependence contributes the most to the global burden of disease attributable to drug use, primarily due to opioid's substantial contribution to premature mortality, high disability, and the comparatively large population of dependent opioid users globally.[1] In the USA, opioid dependence, including heroin and prescription pain killers,[2,3] has doubled in the past decade and involves ~5 million Americans with ~17,000 deaths[4] and ~650,000 emergency room visits annually.[5] In addition to prescription opioid misuse being associated with transition to injected opioids and misuse of other drugs,[6,7] opioid use disorders are also associated with significant medical and psychiatric co-morbidities and adverse social, familial, vocational, and legal consequences.[8,9] Injected opioids are also associated with increased blood-borne infections like viral hepatitis and human immunodeficiency virus (HIV).[8] Many non-addiction comorbidities accompany substance use,[10–12] and provision of primary care services may improve addiction outcomes.[13] Societal costs of opioid addiction exceed $55.7 billion annually, yet many of the negative consequences of opioid dependence are preventable through effective evidence-based treatments. Treatment of opioid dependence, a chronic and relapsing condition, is most effective using opioid-substitution therapy (OST) like methadone (MMT) or buprenorphine (BMT) maintenance treatment.[14,15] Since 2002, certified US physicians could prescribe BMT in primary care and specialty care settings, thereby improving availability and access to treatment for opioid dependence.[16,17]

The Affordable Care Act (ACA) seeks to increase access to affordable, high quality health-care, including expanded health-care delivery options for addiction treatment in federally qualified health centers (FQHCs) and creation of patient-centered medical homes (PCMHs). PCMHs emphasize comprehensive, coordinated, accessible care, with a systematic focus on *quality*, including indicators of preventive and treatment services. The Agency for Healthcare Research and Quality (AHRQ) recognizes that revitalizing primary care, sites where most preventive care is provided, is key to achieving high quality, accessible, and efficient health care,[18] including for those with substance use disorders (SUDs) and significant health-care disparities.[18,19] The prevalence of SUDs is proportionately higher among the urban poor, especially racial/ethnic minorities and low-income groups,[4] especially in Connecticut,[20] justifying integration of BMT into FQHCs to reduce health disparities.[21]

Thus, integrating BMT into FQHCs is crucial to increase drug treatment access and to engage opioid-dependent individuals in primary health care,[22] particularly since they experience higher age-matched morbidity and mortality than non-drug users for a number of preventable conditions.[8,23–29] We recently documented real-world clinical effectiveness of integrating BMT into FQHCs,[30] with BMT retention (56.8 % at 6 months and 61.6 % at 12 months) being similar to findings from other trials.[22,31–34] In recognition that medical screening is the first and necessary step for improving outcomes for most medical conditions, this study was a pre-planned secondary analysis of a recently described longitudinal cohort of 266 patients.[30] Findings from this study are now extended by examining how BMT, when integrated within FQHCs, is associated with improved quality health-care outcomes beyond solely treating opioid dependence. Improved health includes prevention, diagnosis, and treatment of clinically common co-morbid medical conditions, which has not previously been examined. This study directly addresses the first step in the treatment cascade and preventive health-care screenings and examines the hypothesis that opioid-dependent patients treated with BMT when integrated into FQHCs should

be associated with improved screening for recommended preventive care screenings and further seeks to explore patient and health-care setting factors associated with higher screening levels. These screenings, which are termed quality health-care indicators (QHIs), include four infectious conditions for which this population is at increased risk [i.e., HIV, hepatitis B (HBV), hepatitis C (HCV), and syphilis] and five chronic medical conditions that require routine screening in the general population (i.e., hypertension, hyperlipidemia, and cervical, breast, and colorectal cancer). The QHIs were chosen a priori for this study population based on nationally recommended general and risk-based screenings promoted as part of quality primary health-care delivery.

METHODS

Study Setting and Sample

The study location and sample, BMT program description, eligibility criteria, and variable definitions have been previously described.[30] Briefly, 266 opioid-dependent adults initially prescribed even a single buprenorphine dose from July 1, 2007 through November 30, 2008 at the two largest urban Community Health Center, Inc. sites, Connecticut's largest FQHC network, were analyzed using longitudinal data from the electronic health record (EHR) in a prospective observational study. All patients had health insurance, with nearly all having Medicaid, which covers BMT under its prescription plan in Connecticut. The analysis of de-identified longitudinal EHR data used for secondary analysis was deemed exempt, and expedited IRB approval was granted.

Community Health Center, Inc. has nearly 50 medical prescribers, half of whom are physicians and half are advanced clinical nurse practitioners (NPs) that provide care for approximately 130,000 patients at 12 sites throughout Connecticut. Both primary care physicians (PCPs) and psychiatry specialists prescribe BMT within this FQHC network; only one PCP at CHC is board-certified by the HIV Medical Association, and none are certified in Addiction Medicine or Addiction Psychiatry. Only physicians can prescribe BMT; however, NPs work collaboratively with BMT prescribers and clinically oversee the day-to-day clinical management of BMT patients. PCPs, on average, are scheduled to see 22–25 patients per day. Each PCP is assisted by an assigned nurse and medical assistant, whereas psychiatrists have access to behavioral counselors. All HIV-infected patients have a case manager funded by Ryan White; otherwise, there are no case managers or social workers at CHC, Inc. Behavioral health providers often use a standardized behavioral health template; however, PCPs may create their own encounter template in the EHR, though most do not. No standardized electronic "pop-ups" were deployed in the EHR during the observation period. All patients at CHC, Inc. are contacted by phone and/or by mail about upcoming CHC appointments with their PCPs or behavioral health providers and about external referrals. Missed appointments to all CHC providers, external specialists, and diagnostic testing are followed up with phone calls and/or a letters in order to facilitate rebooking.

All subjects minimally had 6 months or longer of EHR observation beyond their initial buprenorphine prescription (range=6.0–21.5 months). EHR data included age, sex, type of provider (PCP or psychiatry specialist), medical and psychiatric co-morbidities, provision of medical and behavioral health care, on-site addiction counseling, retention in BMT, and urine testing for opioid and cocaine use. All BMT-prescribing physicians were FQHC employees. BMT retention at 1, 3, and

6 months was previously reported as 88.4, 71.8, and 56.8 %, respectively, and 6-month BMT retention was positively associated with being prescribed psychiatric medications and receiving on-site addiction counseling and negatively with cocaine use.[30] The current analysis builds on these findings by assessing nine nationally recommended quality health-care indicator preventive screenings (Table 1).

TABLE 1 Nine nationally recommended preventive health-care screenings

	Screening	Agency	Target population	Screening details
Infectious diseases	HIV	CDC	Any	Within 12 months after BMT induction; if already HIV+, to have CD4 and HIV-1 RNA monitored within 12 months
	HCV	AASLD	Any	Within 12 months after BMT induction; if already HCV+, to have LFTs and HCV RNA monitored within 12 months
	HBV	AASLD	Any	Within 12 months after BMT induction; if already HBV Ag+, to have LFTs and HBV DNA monitored within 12 months
	Syphilis	USPSTF	Any	Within 12 months after BMT induction
Chronic conditions	Hyperlipidemia	USPSTF	Diabetics ≥20 years; men ≥35 years; women ≥45 years	Within 12 month after BMT induction
	Hypertension	USPSTF	Any	A minimum of two independent blood pressure assessments at least 1 week apart within 12 months after BMT induction
	Cervical cancer	ACOG	Women only	Papanicolau smear within 2 years of BMT induction if they had not had a total hysterectomy for benign reasons and no previous history of high grade cervical dysplasia
	Breast cancer	ACOG	Women only	Mammogram within 2 years of BMT induction for women aged 40–49 and within 1 year for women ≥50 years
	Colorectal cancer	USPSTF	Age ≥50 years	Colonoscopy within 10 years, sigmoidoscopy within 5 years, or a fecal occult blood test (FOBT) within 1 year

CDC Centers for Disease Control and Prevention, *AASLD* American Association of Study of Liver Disease, *USPSTF* US Preventive Services Task Force, *ACOG* American College of Obstetricians and Gynecologists

Study Definitions

In this analysis, pre-planned independent variables (see Table 4) were age; gender; provider specialty (primary or psychiatry specialty care); 1-, 3-, and 6-month BMT retention; opioid-free time as previously defined from the parent study[30]; any cocaine use during the observation period; assessment of continued health-care visits irrespective of whether they discontinued BMT and defined as having a FQHC visit within 1 month prior to or 12 months after the end of the observation period; reason for FQHC engagement defined as 'primarily for BMT' if BMT initiation occurred before becoming registered in ongoing care or 'primarily for primary care' if BMT enrollment occurred 1 month or more after the first FQHC visit; co-morbidities based on International Classification of Diseases, 10th Revision (ICD-10) coding in the EHR including mood disorders (depression, anxiety, bipolar, or psychotic disorders), HIV, and HCV infection; number of visits per month to the FQHC; and receipt of at least one on-site individual or group addiction counseling visit. These variables were chosen *a priori* based on expected and potential influences on primary care engagement. Based on previous studies that documented BMT retention was associated with reductions in emergency department use[35] and improved HIV treatment[31] outcomes (being prescribed antiretroviral therapy and achieving viral suppression), we hypothesized that it would potentially influence preventive screenings. Retention on BMT was modeled for 1-, 3-, and 6-months, with 3-month levels providing the best goodness-of-fit. Similarly, we hypothesized that PCPs are typically responsible for preventive health care and would result in higher QHI scores. Composite or individual QHI scores were reported based on the initial BMT induction date. Based on previous findings reported for this cohort, since opioid dependence is a chronic relapsing disease, many individuals underwent repeated inductions,[30]and it was impossible to relate a specific QHI to either the original or the subsequent induction. All other pre-planned variables included in the analysis were based on the Behavioral Model of Health for Vulnerable Populations,[36,37] such as competing co-morbidities, cocaine use, ongoing opioid use, reason for FQHC engagement, and frequency of contact with the FQHC, recognizing that other variables that were not used (e.g., homelessness) would be unreliable from the EHR.

Because patients with SUDs have or are at risk for multiple co-morbid conditions, the nine nationally recognized primary health-care screening QHIs were selected as dependent variables to more holistically examine incremental benefits of BMT beyond improvements in addiction. Moreover, they were assessed because such preventive screenings, the first step in the treatment cascade, are central to PCMHs, which are designed to provide comprehensive care. The selected screening QHIs and the criteria that needed to be met (see Table 1) include the following: (1) HIV[38,39], (2) HCV[40], (3) HBV[41], (4) syphilis[42], (5) hyperlipidemia[43], (6) cervical cancer[44], (7) breast cancer[45], (8) colorectal cancer[46], and (9) hypertension.[47]

A composite screening QHI score (QHI-S), based on previously described HIV-specific primary care QHIs,[48] was calculated as the percentage of completed QHIs for which a subject was eligible (maximum=100 %). Benchmarks of 80 and 90 % were used as cut-offs for recommended and optimal comprehensive quality care, respectively. The optimal 90 % cut-off was selected based on the National Committee for Quality Assurance's (NCQA) 90th percentile benchmark used for comparing optimal Healthcare Effectiveness Data and Information Set (HEDIS) scoring for private, Medicaid and Medicare accreditation. HEDIS is used by most US health-care plans to measure performance on various aspects of quality care delivery including breast, cervical and colon cancer screening. An 80 % benchmark was explored here to provide a recommended cut-off for future thresholds.

Data Analysis

Missing data were infrequent,[30] and the propensity of missingness was not found to be statistically related to QHIs. Covariate data were assumed to be missing at random (MAR) and imputed using a Markov Chain Monte Carlo simulation conditional on the observed variables.[49] Additional simulations showed that our results were not sensitive to departures from the MAR assumption. Using a logistic regression, we examined the relationship between QHIs and all pre-specified covariates. Covariates on univariate analysis found to be statistically significant at $p<0.20$ were modeled to determine which variables accounted for most of the variation in the QHI-S and subsequently included in the multivariate framework. The final model selection was based on goodness-of-fit using the Akaike information criterion. The Wald test was used to assess the significance of the coefficients. All statistical analyses were conducted using STATA v.11.2 (StataCorp, College Station, TX, USA).

RESULTS

Demographic and co-morbidity data for the 266 eligible subjects are listed in Table 2. Of note, subjects were in their early 40s (mean=40.1 years), mostly male (69.2 %), prescribed buprenorphine by a PCP (70.3 %), and initially established their care at the FQHC primarily seeking BMT (80.5 %). Subjects had significant co-morbid conditions, including HIV (10.9 %), HCV (59.8 %), and a mood disorder (71.8 %), with 65.0 % of the cohort prescribed psychiatric medications.

TABLE 2 Baseline characteristics of 266 opioid-dependent patients receiving buprenorphine

Patient characteristic	*N* (%)
Age, mean (range)	40.1 (20–64)
Gender	
Male	184 (69.2)
Female	82 (30.8)
Urban clinical site	
Meriden	157 (59.0)
New Britain	109 (41.0)
Specialty of buprenorphine prescriber	
Primary care	187 (70.3)
Psychiatry	79 (29.7)
Main reason for entry into federally qualified health center	
Buprenorphine maintenance treatment	214 (80.5)
Primary care treatment	52 (19.5)
Patients continuously engaged in health care even when BMT discontinued	22 (8.3)
Co-morbidities (based on ICD-10 coding in medical record)	
HIV infection	29 (10.9)
HCV infection	159 (59.8)
HBV infection	3 (1.1)
Metabolic disorder (diabetes, hypertension, hyperlipidemia, coronary artery disease)	94 (35.3)
Pulmonary disorder (chronic obstructive pulmonary disorder, asthma)	47 (17.7)
Mood disorder (depression, bipolar disorder, anxiety disorder)	191 (71.8)
Prescribed medication for comorbid psychiatric condition	173 (65.0)

BMT buprenorphine maintenance therapy, *ICD-10* International Classification of Diseases, 10th revision

Nearly all (90.6 %) patients initiating BMT attended at least one medical visit with these subjects averaging 1.7 medical visits per month. Overall, 56.3 % attended at least one behavioral health visit, averaging 1.6 behavioral health visits per month. Over half (53.0 %) of patients attended at least one on-site addiction counseling visit, averaging 1.2 visits per month while on BMT. For the total cohort, each subject averaged 3.1 FQHC visits for any reason per month of BMT, ranging from 0.5 to 8.3 visits per month (see Table 3).

The percentage of the cohort that underwent testing for each of the primary care QHIs for which they were eligible is shown in Fig. 1. The individual QHI screening results were 71.4 % for HIV, 80.1 % for HCV, 76.3 % for HBV, 49.3 % for syphilis, 72.9 % for hyperlipidemia, 91.0 % for hypertension, and 44.4 % for breast, 58.5 % for cervical, and 48.7 % for colorectal cancer. A composite QHI-S of ≥80 and ≥90 % was achieved by 57.1 and 28.6 % of the cohort, respectively. After controlling for covariates significant at $p<0.2$ in the univariate model (see Table 4) associated with a QHI-S of ≥80 %, only male gender, being retained on BMT 3 months or longer, BMT prescribed by a PCP rather than a specialist, and having documented HIV or HCV infection remained significant. Covariates were similar for achieving QHI-S ≥90 %, except that having HCV infection no longer remained significant.

Men were about 70 % more likely than women to achieve a QHI-S of ≥80 and ≥90 %, while BMT retention ≥3 months portended over a 2-fold increased likelihood of achieving a higher QHI-S compared to those retained on BMT shorter periods. Having PCPs prescribe BMT, rather than a psychiatric specialist, was associated with a 3-fold increased likelihood of achieving a QHI-S ≥80 or ≥90 %.

TABLE 3 Types and frequency of health-care utilization at health center while receiving buprenorphine maintenance therapy (*N*=266)

Medical visits[a]	
Number of patients who had at least 1 medical visit (%)	241 (90.6)
Mean number of visits per month of being on BMT for those who had at least 1 medical visit (range)	1.7 (0.07–6.9)
Mean number of visits per month of being on BMT for the total cohort (range)	1.6 (0.0–6.9)
Behavioral health visits[a]	
Number of patients who had at least 1 behavioral health visit (%)	150 (56.3)
Mean number of visits per month of being on BMT for those who had at least 1 behavioral health visit (range)	1.6 (0.05–8.0)
Mean number of visits per month of being on BMT for the total cohort (range)	0.9 (0.0–8.0)
Addiction counseling visits[a]	
Number of patients who had at least 1 addiction counseling visit (%)	141 (53.0)
Mean number of visits per month of being on BMT for those who had at least 1 addiction counseling visit (range)	1.2 (0.05–4.3)
Mean number of visits per month of being on BMT for the total cohort (range)	0.6 (0.0–4.3)
All visits[a]	
Mean number of visits per month of being on BMT for the total cohort (range)	3.1 (0.5 to 8.3)

BMT buprenorphine maintenance therapy

[a]If individuals stayed in treatment for less than a month, the total number of visits was set to a month

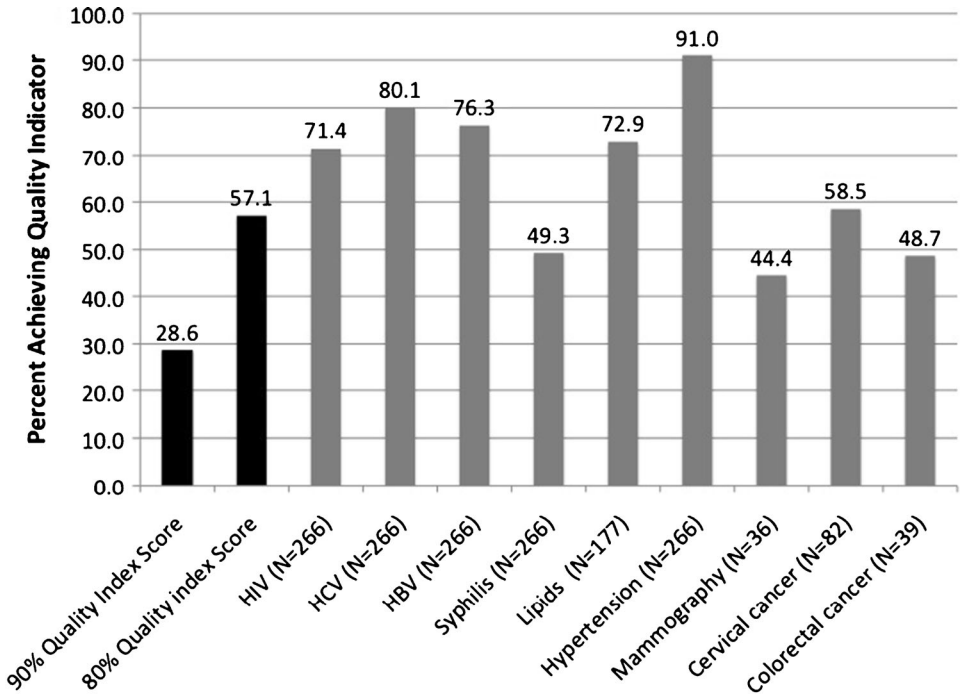

FIG. 1 Proportion of subjects entering buprenorphine maintenance treatment that received screening for primary care quality indicators. *N* number of subjects eligible for screening.

HIV-infected patients were 4- and 8.5-fold times more likely to achieve QHI-S ≥90 and ≥80 %, respectively, compared to their HIV negative counterparts.

DISCUSSION

We previously demonstrated that BMT can be effectively integrated into FQHCs to increase access to evidence-based treatment for opioid dependence, expand the scope of a PCMH and reduce opioid use.[30] This integration of BMT into FQHCs is consistent with World Health Organization (WHO), Joint United Nations Programme on HIV/AIDS (UNAIDS), and Centers for Disease Control and Prevention (CDC) recommendations to integrate services for people with SUDs.[50–52] Important in these findings is that most patients initially entered the FQHC network seeking BMT, suggesting that seeking treatment for their addiction served as an entry point to receive ACA-recommended health-care services, primarily by PCPs.

General and risk-based screening and treatment of co-morbid conditions are integral to primary care mandates, including FQHCs. This study focused on nine preventive QHIs that reflect nationally recognized screening recommendations for all patients as well as for those with SUDs. The findings support that effectively retaining patients on BMT for a relatively short time period, as short as 3 months, increases the likelihood that these patients will undergo recommended screenings compared to those patients who were retained on BMT for shorter time periods. Screening rates that often exceeded 70 % were achieved for many of the recommended disease screenings, particularly those that could be completed with phlebotomy alone, yet rates for other screenings, specifically for cancer, leave room for improvement.

TABLE 4 Covariates associated with higher quality indicator scores

	Quality indicator score of ≥80 %						Quality indicator score of ≥90 %					
	Univariate analysis			Multivariate analysis			Univariate analysis			Multivariate analysis		
Covariates	OR	95 % CI	*P* value	AOR	95 % CI	*P* value	OR	95 % CI	*P* value	AOR	95 % CI	*P* value
Age	1.04	(1.01, 1.07)	<0.001	–[a]			1.00	(0.97, 1.03)	0.94			
Gender												
Male	Referent						Referent					
Female	0.31	(0.17, 0.53)	<0.001	**0.30**	**(0.16, 0.55)**	**<0.001**	0.28	(0.14, 0.57)	<0.001	**0.28**	**(0.13, 0.59)**	**<0.001**
Retention in care (1 month)												
No	Referent						Referent					
Yes	1.89	(0.87, 4.07)	0.10	–[a]			1.77	(0.69, 4.49)	0.23			
Retention in care (3 months)												
No	Referent						Referent					
Yes	1.89	(1.09, 3.24)	0.02	**2.19**	**(1.18, 4.04)**	0.01	2.09	(1.08, 4.03)	0.03	**2.28**	**(1.13, 4.60)**	**0.02**
Retention in care (6 months)												
No	Referent						Referent					
Yes	1.54	(0.94, 2.51)	0.08	–[a]			1.42	(0.82, 2.44)	0.21			
Opioid-free time												
No. of days	1.00	(0.99, 1.00)	0.79				1.00	(0.99, 1.00)	0.54			
% of observed time	1.15	(0.60, 2.20)	0.66				1.41	(0.68, 2.89)	0.35			
Share of opioid positive urines	1.38	(0.64, 2.96)	0.40				1.16	(0.50, 2.66)	0.72			
Urine negative for opioids in last month												
No	Referent						Referent					
Yes	0.95	(0.56, 1.59)	0.83				1.24	(0.71, 2.15)	0.45			
Any cocaine screen												
Negative	Referent						Referent					
Positive	1.01	(0.61, 1.65)	0.97				0.94	(0.54, 1.61)	0.81			
Still in primary care at end of observation												
No	Referent						Referent					
Yes	1.56	(0.91, 2.66)	0.10	–[a]			1.29	(0.70, 2.35)	0.42			

TABLE 4 ***Continued***

	Quality indicator score of ≥80 %						Quality indicator score of ≥90 %					
	Univariate analysis			Multivariate analysis			Univariate analysis			Multivariate analysis		
Covariates	OR	95 % CI	*P* value	AOR	95 % CI	*P* value	OR	95 % CI	*P* value	AOR	95 % CI	*P* value
Entered FQHC primarily for BMT												
No	Referent						Referent					
Yes	1.13	(0.61, 2.08)	0.69				0.96	(0.49, 1.89)	0.92			
Number of visits to FQHC per month	0.90	(0.78, 1.03)	0.15	–[a]			0.96	(0.82, 1.11)	0.59			
Mood disorder												
No	Referent						Referent					
Yes	0.96	(0.56, 1.64)	0.89				0.87	(0.48, 1.55)	0.64			
HIV-infected												
No	Referent						Referent					
Yes	9.35	(2.75, 31.7)	<0.001	**8.69**	**(2.33, 32.3)**	<0.001	4.27	(1.92, 9.46)	<0.001	**3.95**	**(1.62, 9.59)**	<**0.001**
HCV-infected												
No	Referent						Referent					
Yes	2.84	(1.71, 4.71)	<0.001	**2.11**	**(1.19, 3.71)**	**0.01**	2.17	(1.21, 3.86)	0.01	1.59	(0.84, 2.99)	0.15
Prescriber specialty												
Psychiatry	Referent						Referent					
Primary care	2.94	(1.69, 5.09)	<0.001	**3.38**	**(1.78, 6.37)**	<**0.001**	**2.58**	(1.32, 5.02)	**0.01**	2.87	**(1.37, 5.99)**	**0.01**
Onsite addiction counseling												
No	Referent						Referent					
Yes	1.11	(0.68, 1.80)	0.66				0.91	(0.53, 1.54)	0.73			
AIC Goodness of fit				326.0						286.7		

AIC Akaike information criteria, *BMT* buprenorphine maintenance therapy, *OR* odds ratio, *AOR* adjusted odds ratio

[a]Non-significant variables were excluded by AIC criteria in the multivariate model

Bold signifies p<0.05

With the exception of cervical cancer screening,[53] none of the other QHIs have been adequately reported for medically disenfranchised individuals with SUDs, a population with considerable health disparities. Therefore, in order to put these findings into some, albeit less than ideal, context, the screening results were compared to those reported nationally, in Connecticut, and when possible, those reported in similar high-risk populations. Since no equivalent composite screening scores, such as the QHI-S, exist in the national and Connecticut reports, the screenings were described individually.

Many of the study findings were similar to or even better than those reported nationally and in Connecticut. Screening for chronic viral infections was excellent. Although routine HIV screening is recommended for all US adults, especially those with SUDs, current implementation nationally is poor (range, 40.0–50.7 %) and inadequately low (66.4 %) for high-risk individuals with SUDs and STD clinic attendees[54,55] and opioid treatment clinics.[56] Findings from this study (71.4 %) exceed these HIV screening assessments and is markedly higher than reported among addiction specialists in a national sample of BMT-prescribing (46 %)[57] and MMT-prescribing (48.5 %)[58] physicians and by opioid treatment programs (17 %).[56] The difference may be explained, in part, because PCPs generally focus more on health screenings rather than treating addiction alone.

Viral hepatitis screening here was excellent with 76.3 and 80.1 % for HBV and HCV, respectively. Nationally, HBV screening data are unknown but available for some CDC-recommended populations. Screening is high among pregnant women delivering in specialty hospital settings (range, 89–96 %) and low in primary care settings for patients born in high HBV prevalent regions (range, 30–50 %). HBV screening among drug users nationally is low,[59] with only 20.5 % of patients being screened at MMT programs.[58] HCV screening varies widely among high-risk populations (range, 17–87 %) and is low (34.4 %) at specialty MMT programs.[58]

Diagnosis with HIV infection was associated with higher QHI-S, perhaps because dedicated Ryan White-funded HIV programs require reporting of HIV-related QHIs. Given that non-HIV patients did not have a case manager, the impact that the HIV case manager may have had on these screenings is unclear since HIV infection was not found to be significantly associated with BMT retention. Chronic HCV infection was also associated with a higher QHI-S; however, this association is less clear. One explanation is that successful treatment of one co-morbidity (i.e., addiction) improves concern about overall health, resulting in increased health-care engagement with success in one domain leading to clinical gains for other co-morbidities.[35,60]

Syphilis screening is recommended for high-risk groups, including pregnant women, sex workers, and prisoners. Nearly half (49.3 %) of BMT patients were screened for syphilis, markedly lower than for pregnant women but higher than attendees in STI clinics, emergency departments (ED), and MMT programs. Nearly all (99.3 %) pregnant women were screened in one Indiana study,[61] while only 40.4 % of MMT patients[58] and 31 % of patients tested for gonorrhea and chlamydia were also screened for syphilis at STI clinics.[62] Nevertheless, syphilis screening needs improvement in this sample, and findings here argue against the speculation that high overall QHI-S were achieved through single visit phlebotomy testing for HIV, viral hepatitis, and metabolic disorders. Providers, however, may have perceived their patients at low risk due to Connecticut's low syphilis incidence, which is markedly lower (0.41–2.2 versus 4.5 cases per 100,000 population) than national estimates.[63] Furthermore, not everyone in this study's cohort was necessarily at

high risk for syphilis, but they were all included in the screening denominator since syphilis risk was not routinely available in the EHR. Syphilis testing among HIV-infected men in Australia increased by reflexively linking it to other testing (e.g., CD4)[64] and may be one strategy to improve screening rates in patients seeking BMT services at FQHCs.

Hyperlipidemia screening (72.9 %) initially appears lower than reported in Connecticut (82.7 %) and nationally (range, 68.4–77.0 %); yet in this study, the screening time frame was markedly shorter than the lipid screening time frame (past 5 years) reported in Connecticut and national samples.[65–68] With over half (50.4 %) of Americans screened having clinically significant hypercholesterolemia, lipid screening remains a crucial primary care mandate.[67] Similarly, nationally and in Connecticut, 27–29 % of tested adults have hypertension with a quarter being undiagnosed,[66,69] underscoring the importance of hypertension screening. The finding that 91.0 % of BMT patients were screened in the past year was similar (92.9 %) to screening behaviors over a longer 2-year period nationally.[65]

Cervical cancer screening among female BMT patients (58.5 %) was lower than among women nationally (range, 82.9–84.5 %) but higher than for drug-using women in Maryland (range, 26–27 %). In the Maryland study, drug-using women were screened significantly less than non-drug using women, even after controlling for number of clinical visits.[53] Women over 40 years and prescribed BMT also had a low mammography screening rate (44.4 %), which is markedly less than reported among women nationally (range, 73.7–76.0 %) and in Connecticut (range, 81.5–84.1 %). While PCPs in FQHCs can easily screen for cervical cancer on-site, mammography requires off-site referrals. Women with SUDs, however, often experience multiple competing social and medical needs at clinical encounters that are prioritized over procedure-based cancer screenings,[70–72] which forms the basis for recommending integration of women's health care into PCMHs. Colon cancer screening in this sample, which may include off-site referrals, was 48.7 % and close to 2008 national (range, 52.0–54.2 %) and Connecticut (56.6 %) estimates for age-appropriate adults but lower than 2010 (64.5 and 74.9 %, respectively) estimates.[65,66,73,74]

Cancer screening comparisons should be interpreted with caution, however, since our findings rely on objective chart review, while national and state statistics are derived from self-reported surveys that may overestimate actual preventive screening practices. Each cancer screening assessed, including on-site Papanicolau smears performed by PCPs, often requires a dedicated visit and may be delayed because drug treatment priorities often supersede performing procedures, especially those perceived by patients as uncomfortable or invasive. Nevertheless, further implementation science strategies need to disentangle patient-, provider-, and system-level barriers and facilitators that influence preventive cancer screening practices.

Notwithstanding the findings that preventive screening rates differed depending on the co-morbidity being assessed within this study, when reviewing the various screenings rates reported elsewhere, integrating BMT into the FQHCs and engaging these patients in care for at least 3 months on BMT resulted in increased composite preventive screenings when these compared to those who were retained less and for those patients whose BMT prescribers were PCPs rather than psychiatry specialists. These improved QHI screening are consistent with three important observations linking BMT retention with improved outcomes for co-morbid conditions, including: (1) HIV-infected patients retained on BMT longer were significantly more likely to be prescribed ART and achieve virological suppression[31]; (2) HIV-infected

patients released from prison and retained on BMT were significantly more likely to maintain viral suppression than those not retained[60]; and (3) each month of BMT retention portended a 17 % reduction in emergency department use.[35] Together, these findings suggest that simultaneously engaging patients in longitudinal care while treating their addiction treatment improves health outcomes, specifically an increased likelihood that more preventive QHIs were achieved. This improvement may have been either because BMT stabilized patients' lives thereby allowing increased engagement with clinicians or the repeated encounters for BMT prescription created more opportunities to screen patients. Either way, BMT retention for as short as 3 months allowed for adequate ability to address important aspects of health in addition to addiction itself.

Providing BMT in FQHCs, especially when PCPs were simultaneously treating addiction and general health for at least 3 months, allowed for the opportunity to address non-addiction QHIs and may be part of our armamentarium for overcoming health-care disparities for marginalized urban patients with SUDs. Until now, there are only limited data affirming the benefits of integrating addiction treatment into other aspects of clinical care. In one study where BMT was integrated into HIV care settings, BMT retention not only improved HIV treatment outcomes,[31] but it did so for a range of HIV-specific QHIs[48] and HIV-related quality of life.[75] In Ukraine, integrating methadone into HIV care resulted in markedly improved QHIs for addiction, HIV, and TB, compared to patients whose care was not integrated.[76] Additionally, BMT retention has also resulted in other benefits in primary care settings, including reduced ED utilization[35] and HIV-related risk behaviors.[77] Together, these results support BMT integration into routine primary health-care settings,[16,17,35,78] which in turn improves access to evidence-based addiction treatment.

The finding that a higher QHI-S was associated with BMT prescription by PCPs rather than psychiatry specialists is consistent with integrated care models for patients with SUDs.[16,50,51,79] These observed findings do contrast with self-reported intentions by addiction specialists who indicated an increased likelihood to screen for HIV over their non-specialist counterparts.[57] Moreover, the present study was not constrained to a single screening criterion, such as HIV, but objectively and more comprehensively examined documented multiple preventive screening recommendations, individually and collectively, using a composite outcome that better represents PCMH goals. Furthermore, this study's findings underscore that, though primary and psychiatric care may be co-located within FQHC networks, PCMH-recommended integration may be improved through better communication between disciplines and perhaps through access to similar or shared ancillary staff as the PCPs, such as nursing or medical assistants, in order for patients to fully benefit from such integration.

Concerning here is that women independently fared poorly compared to men. This is partly explained by two of the four lowest QHIs used to create the composite QHI-S being unique to women (breast and cervical cancer screening). Although not presented, women still fared worse after removing these two gender-specific QHIs from the analysis, and remained negatively correlated with recommended (QHI-S, $\geq$80 %) preventive screening outcomes. One explanation may be gender-related differences in socioeconomic status, not measured in this study, since poverty has been associated with lower cervical and breast cancer screenings.[80,81] Moreover, poorer HIV health outcomes have been described for women with SUDs compared to men.[82–84] Other contributors to poor health for women include interpersonal

violence experiences,[70] competing responsibilities like caring for children, families, and work and the potential differences in perceived risk by providers between genders.[85,86] Differential use of supportive services by women and men is an unlikely reason for these differences since the FQHC does not provide case management or other supportive services that are gender-specific.

Integrating BMT within FQHCs creates an important opportunity to provide direct access to comprehensive health care not generally available in addiction specialty facilities.[58] Fewer than half of all addiction treatment[87] and only a sixth of opioid treatment facilities[56] provide any on-site screening, primarily because most "carve-out" addiction treatment funding does not provide for non-addiction medical staff or testing. Thus, integrating BMT into FQHCs not only achieves addiction treatment outcomes similar to that found in specialized addiction treatment programs[30] but also provides an opportunity to improve overall health-care screening and potentially reduce health-care disparities for racial/ethnic minorities and low-income individuals who disproportionately experience drug dependence.[88]

Aside from previously noted limitations, the study's observational and retrospective nature does not determine causality or rule out the presence of endogeneity and selection effects. The large sample size, however, provided sufficient power to examine the impact of BMT retention on individual and multiple preventive QHIs. The composite QHI-S, though adapted from a similar study of HIV-infected patients receiving BMT, has not been validated for primary care patients. Such QHI scores, however, are increasingly used to provide a more comprehensive measurement of integrated care, both domestically[48] and internationally.[76] Here, the composite QHI score lent additional support for PCPs, beyond that of psychiatric specialists within the same setting, who had similar drug treatment outcomes,[30] to achieve higher composite preventive screening scores in their patients. While it is possible that patients prescribed BMT by psychiatrists might have received primary care outside the FQHC, generally, most patients at this FQHC have no other source of care. Prospective controlled studies, however, are warranted to confirm whether PCPs who integrate BMT services into primary care simultaneously achieve similar addiction outcomes while attaining benefits across a number of other health-care domains, such as chronic disease management outcomes. Many important previously described clinician and health-care setting variables[89] that are crucial for successful provision of BMT were not able to be included in our analysis due to how the cohort was constructed from the EHR. Further implementation science studies should incorporate multi-level covariates into determining those characteristics of more successful programs. Moreover, this study focused solely on the first step of the treatment cascade—screening for co-morbid conditions. Quality indicators for managing already diagnosed conditions, such as hemoglobin A1C for diabetes, were not part of this study's pre-planned analysis. Future studies should, however, examine the impact of BMT in improvements along the treatment continuum, including screening, diagnosis, treatment, and more distal health-care outcomes.

Having two large urban sites assessed within this network improves the generalizability of the findings with outcomes not differing between sites. Nevertheless, findings need to be interpreted with caution when attempting to apply them to other FQHCs. Last, absent from this study is incorporation of screening for psychiatric disorders. Nonetheless, the high rates of psychiatric diagnoses (71.8 %) and prescription of psychiatric medications (65.0 %) listed in the patients' EHR

confirm a high prevalence of psychiatric disorders among BMT patients, which would have made collection of psychiatric screening using standardized methods difficult since most patients were already diagnosed.

Last, having a comparison group such as opioid-dependent patients not receiving any treatment would have strengthened the findings. Identifying such comparison groups, however, would have been fraught with considerable selection bias (i.e., differing motivation for addiction treatment), would have likely made our associations even greater and was beyond the scope of this pre-planned secondary analysis. Nevertheless, the pre-planned analysis was based on strategies in previous cohort studies of patients prescribed BMT where those retained on BMT had improved treatment outcomes.[31,35]

Retaining opioid-dependent patients on BMT in primary care settings, even as briefly as 3 months, contributes to improved health outcomes through increased preventive health screenings for a population that is generally challenging to engage in health care. These data affirm that FQHCs not only provided effective treatment for opioid dependence, but simultaneously potentially reduced health disparities through engagement in numerous QHIs like recommended preventive primary health-care screenings.

CONCLUSIONS

BMT can be effectively integrated into primary health-care settings like FQHCs. While BMT effectively improves opioid use outcomes, evidence here suggests that it is an effective strategy to engage patients in primary care, including the completion of a number of nationally recommended preventive health-care screenings that were instituted through development of national guidelines to address health disparities, including for individuals with underlying SUDs. BMT had its greatest impact on preventive screenings at FQHCs for those patients who were successfully retained on BMT for 3 months or longer and when BMT was prescribed by PCPs rather than by specialty psychiatrists. Additional services that target the unique needs of opioid-dependent women, however, are urgently needed for them to achieve parity in these health-care screenings. Additionally, as Substance Abuse and Mental Health Services Administration (SAMHSA) is now training NPs to treat opioid dependence using BMT, it is central to FQHCs and the ACA that treatment is expanded accordingly so that these benefits can be conferred to opioid dependent patients treated by NPs who are increasingly becoming part of the health-care delivery system and who screen for and treat many medical and psychiatric comorbidities. Finally, further studies are required to examine potential advantages of integrating BMT into primary care settings not only on preventive screenings, but to improve co-morbid disease diagnosis and management of chronic diseases.

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a. Literature Review: Haddad, Zelenev and Altice
b. Statistical analysis: Zelenev, Haddad, and Altice
c. First draft of manuscript: Haddad
d. Data management: Haddad and Zelenev
e. Study Design: Haddad, Zelenev and Altice

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