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Methadone Dose, Take Home Status and Hospital Admission among Methadone Maintenance Patients

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Abstract

Objectives—Among patients receiving methadone maintenance treatment (MMT) for opioid dependence, receipt of unobserved dosing privileges (take homes) and adequate doses (i.e. 80mg) are each associated with improved addiction treatment outcomes, but the association with acute care hospitalization is unknown. We studied whether take-home dosing and adequate doses (i.e. 80 mg) were associated with decreased hospital admission among patients in a MMT program.

Methods—We reviewed daily electronic medical records of patients enrolled in one MMT program to determine receipt of take home doses, methadone dose 80mg and hospital admission date. Non-linear mixed effects logistic regression models were used to evaluate whether take home doses or dose 80mg on a given day were associated with hospital admission on the subsequent day. Covariates in adjusted models included age, gender, race/ethnicity, HIV status, medical illness, mental illness, and polysubstance use at program admission.

Results—Subjects (n=138) had the following characteristics: mean age 43 years; 52% female; 17% HIV-infected; 32% medical illness; 40% mental illness; and 52% polysubstance use. During a mean follow-up of 20 months, 42 patients (30%) accounted for 80 hospitalizations. Receipt of take homes was associated with significantly lower odds of a hospital admission (AOR 0.26; 95%CI: 0.11-0.62), whereas methadone dose 80mg was not (AOR 1.01; 95% CI: 0.56-1.83).

Conclusions—Among MMT patients, receipt of take homes, but not dose of methadone, was associated with decreased hospital admission. Take home status may reflect not only patients' improved addiction outcomes, but also reduced healthcare utilization.

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Keywords

Methadone maintenance treatment; dose; take home status; hospital admission

INTRODUCTION

Methadone maintenance treatment (MMT) in the United States is provided in federally-regulated clinics that typically operate separate and in-parallel to mainstream medical care. While methadone dosing should be individualized, as methadone metabolism exhibits individual variability, (Lugo et al., 2005) higher doses are more effective than lower doses at retaining patients in treatment, (Peles et al., 2010) diminishing craving, providing opioid blockade and thus minimizing illicit opioid use and decreasing injection frequency (National Consensus Development Panel on Effective Medical Treatment of Opiate Addiction, 1998; Strain et al., 1999; Faggiano et al., 2003; Center for Substance Abuse Treatment, 2005) National surveys of MMT programs have shown the average methadone dose has been increasing since the 1980s and programs with higher average doses are more likely to be accredited by the Joint Commission. (D'Aunno and Pollack, 2002; Pollack and D'Aunno, 2008) Thus, sufficiently high methadone dose may be one marker of MMT quality.

A "take home" is a dose of methadone given to the patient to take unobserved at home in place of requiring a return to the clinic a subsequent day for observed dosing. Contingent take home doses are offered as rewards to patients with regular clinic attendance, counseling attendance and abstinence from illicit drug use as measured typically by urine toxicology tests. (Center for Substance Abuse Treatment, 2005) With adherence to MMT program expectations, take home doses may increase up to a maximum of 6 or 13 consecutive doses, so eligible patients present to clinic every one or two weeks. Thus, contingent take home dosing results from and re-enforces success in MMT and is another potential marker of MMT quality. In a cohort study, it has been associated with longer retention in treatment and survival. (Peles et al., 2011) Controlled studies have demonstrated that contingent take home dosing increases abstinence from heroin and cocaine use (Chutuape et al., 1999; Chutuape et al., 2001) and increases counseling attendance. (Kidorf et al., 1994)

As easily measurable markers of treatment adequacy and treatment success, methadone dose and take home status may also reflect improved healthcare utilization. Patients receiving adequate methadone dosing and who have treatment success may be less likely to use acute hospital services, as they may be more capable of self-management (i.e., attending to their medical needs). Addiction treatment generally is associated with decreased utilization of acute hospital services, and in some cases lower overall costs. (Laine et al., 2001; Weisner et al., 2001; Parthasarathy et al., 2003; Laine et al., 2005; Friedmann et al., 2006; Gourevitch et al., 2007) However, it is not clear which aspects of methadone maintenance treatment are associated with improved medical care utilization.

In the setting of national health reform and the prospect of parity for the treatment of substance use disorders, the impact of MMT on the broader health system, should be of interest to policymakers, providers and patients. The determination of factors that reflect effective MMT will assist with evaluating health system outcomes. In this study we reviewed the MMT and hospital electronic medical records (EMRs) of patients to determine longitudinally whether an association exists with hospital admission and two easily accessible clinical factors: 1) methadone dose and 2) take home status.

METHODS

Study Design and Population

We conducted a retrospective medical record review of patients in the Boston Public Health Commission (BPHC) methadone maintenance treatment (MMT) program from February 1, 2006 to March 30, 2008. Only those individuals who met the following criteria were eligible for analysis: 1) enrolled in methadone maintenance treatment on March 30, 2008 2) received primary medical care from Boston Medical Center (BMC), an affiliated but physically and institutionally distinct medical center; and 3) had provided an active two-way release of information with a BMC primary care physician. The release permitted ongoing exchange of medical information between the BPHC MMT program and providers at BMC for the purpose of clinical care coordination. This release was typically initiated at enrollment in MMT. For the purposes of the study, we linked patient data between the MMT program and the hospital. Investigators did not have direct contact with any study subjects as this study was a retrospective review of medical record data and therefore did not obtain any informed consents. This study was reviewed and approved by the Institutional Review Board of Boston University and Boston Medical Center, on behalf of the Boston Public Health Commission.

Data Collection and Measures

Outcomes—The primary outcome of the study was hospital admission (yes vs. no) on a given day. To document hospital admissions the medical record reviewers recorded start and end dates for each hospitalization listed in the MMT EMR from February 1, 2006 to March 30, 2008. The MMT nursing staff was informed either by hospital staff or the patient upon return about any hospitalization that resulted in a missed methadone dose. The nursing staff documented the dates, diagnoses, and locations of these hospitalizations in the MMT EMR after direct communication with the hospital staff. Forty-four (80%) of 55 hospitalizations reported to have occurred at BMC were confirmed in the BMC EMR. Periods when patients had no opportunity to receive take homes were excluded from analyses. These periods included the first 90 days of program admission, days incarcerated, and days hospitalized. Periods of known pregnancy were recorded and excluded due to expected hospitalizations during this time (pregnancy complications or child birth).

Independent Variables—There were two main independent variables in the study: methadone dose (≥ 80 mg vs. < 80 mg) and receipt of take home (yes vs. no) on a given day. Methadone dose and take home status were extracted from the MMT electronic medical record (EMR) for each day the subject was enrolled from February 1, 2006 to March 30, 2008. Take homes are the primary incentive MMT programs use for positive reinforcement for patients who are succeeding in treatment and are granted after at least 90 days of complete methadone dosing attendance, counseling attendance, and no evidence of any illicit substances as determined by urine drug testing. Daily methadone doses were categorized as ≥ 80 mg or < 80 mg. This categorization was based on previous studies which demonstrated doses ≥ 80 mg were associated with improved treatment outcomes.(Strain et al., 1999) Both methadone dose and take home status were modeled as time-dependent variables.

Covariates—From the BPHC electronic medical record EMR, reviewers recorded age, gender, race/ethnicity, and polysubstance use at the time of MMT admission. Race/ ethnicity categories included three mutually exclusive categories – non-Hispanic white, non-Hispanic black/ African-American and Hispanic. Subjects were categorized with polysubstance use if alcohol, cocaine, or benzodiazepine (non-prescribed) use was noted at methadone program admission. From the BMC EMR, we also recorded the active co-occurring medical and

mental health conditions. Subjects were categorized as having medical illness if they had any of the following diagnoses documented: chronic obstructive pulmonary disorder, diabetes, renal disease, hypertension, cancer, pancreatitis or hypercholesterolemia. HIV status was documented and included as a covariate separately from other medical conditions. Subjects were categorized as having mental illness if they had a mood, thought, or anxiety disorder documented.

Analysis

Descriptive statistics of all subject characteristics at study entry were obtained and stratified by take home status (ever versus never) and dose status (always <80mg versus ever ≥80mg). We used non-linear mixed effect logistic regression models to evaluate whether receipt of take homes or high dose methadone were associated with a hospital admission on the following day. The mixed effects regression model was used to incorporate multiple observations available from the same individual (e.g. subjects could have repeated hospitalizations) in the analysis while controlling for the correlation within individuals in order to obtain proper estimates of variability. The primary analysis included both independent variables in the same adjusted model. Because some previous studies define 60mg of methadone as “high dose,” (Faggiano et al., 2003) we repeated the model using a definition of 60mg or higher in a sensitivity analysis. Covariates in the adjusted model included age, gender, race/ethnicity, HIV status, chronic medical illness, mental illness, polysubstance use, length of time in treatment prior to study enrollment, and time since baseline. To minimize the potential for collinearity, we assessed correlation between pairs of independent variables and verified that no pair of variables included in the same regression model was highly correlated (i.e., $r > 0.40$). Analyses were conducted using two-sided tests and a significance level of 0.05. All analyses were performed using SAS software version 9.1.

RESULTS

Of the 365 patients enrolled in the MMT program, 71 (19%) had no release signed for communication with a primary care physician and 128 (35%) had a signed release, but not with a physician at the affiliated medical center. Of the remaining 166 subjects screened, 28 were excluded because they had been enrolled in MMT less than 90 days as of March 30, 2008. Hence, 138/365 patients (39%) were ultimately found eligible and included in study analyses. (Figure 1)

The following were patient characteristics at study entry: mean age of 43 years; 52% female; 49% white, 29% black or African American, and 22% Hispanic; 17% HIV-infected; 32% chronic medical illness; 40% mental illness; and 52% polysubstance use. Table 1 details patient characteristics overall and stratified both by take home status and by methadone dose (≥80mg or <80mg). Among the study patients, 52% had at least 1 documented take home during the follow-up period and 75% had at least 1 documented methadone dose ≥80mg. Those patients who ever received take homes were less likely to have polysubstance use at baseline, were older, had more follow-up months during the study and more months in treatment before the study. Those patients with a dose always <80mg were less likely to have mental illness or polysubstance use, and had fewer follow-up months during the study. Among the 138 subjects, the total number of eligible observed days in MMT was 83,149 and the mean duration of follow-up time was 20 months. Of the 80 hospital admissions among 42 (30%) subjects, 9 (11%) admissions were among subjects with take homes and 50 (62.5%) admissions were among subjects with ≥80mg of methadone. The overall hospitalization rate was 0.35 hospitalizations per person-year of eligible treatment days.

In models adjusted for age, gender, race/ethnicity, mental and medical illness, HIV infection and polysubstance use, receipt of take homes was associated with significantly lower odds of a hospital admission (OR 0.26; 95% CI: 0.11-0.62), whereas dose 80mg was not (OR 1.01; 95% CI: 0.56-1.83) (Table 2). In a sensitivity analysis, methadone dose of 60mg was also not significantly associated with hospital admission. In both models, medical illness was associated with increased odds of hospital admission. Common hospitalization diagnoses were typical for that seen in an urban hospital and are listed in Table 3.

DISCUSSION

Among MMT patients with established medical care, those with demonstrated treatment success in MMT as defined by achieving unobserved dosing privileges (i.e., take home doses), had one quarter the odds of hospital admission compared to those not receiving take home doses. Thus, achieving take home doses represented not only substantial addiction treatment success, but also a marked decreased risk of medical hospitalization during this period. Although this analysis does not determine whether take home status directly reduces hospitalization or is a marker of other unmeasured factors, it does account for other known predictors of hospital admission, including age, HIV infection, chronic medical illnesses, and mental illness.

We found no evidence the dose of methadone was associated with decreased hospitalization. The observed lack of association between doses greater than 80mg and hospitalization suggests that the benefits of a higher dose do not include decreased hospital admissions.

The Office of National Drug Control Policy (ONDCP) 2010 Strategy highlights increasing quality and performance within addiction treatment as a key objective and using quality and performance measures to improve addiction treatment. (Office of National Drug Control Policy, 2010) The treatment of opioid dependence with pharmacotherapy, (e.g. MMT) is one of 11 evidence-based practices identified by the National Quality Forum and cited by the ONDCP for widespread adoption. Providing pharmacotherapy for opioid dependence should include demonstrating treatment quality and performance. Hospitalization is an important outcome to consider due to both health and cost implications. Adequate MMT dosing is already recognized as a measure of MMT effectiveness in that lower doses result in poorer addiction treatment outcomes. (National Consensus Development Panel on Effective Medical Treatment of Opiate Addiction, 1998; Strain et al., 1999; Faggiano et al., 2003; Center for Substance Abuse Treatment, 2005) Take home status has been less studied, but by definition it is a marker of treatment success, because abstinence from drugs, participation in counseling and daily dosing are required to receive take homes. However, whether or not such success extends to utilization of medical resources has not been examined in previous studies. By demonstrating an association between take home status and hospitalization, an important medical and health system cost outcome, this study supports consideration of take home status as a useful performance measure reflecting direct benefit to individual patients as well as the wider healthcare system.

This study's strengths included the use of the daily MMT program EMR which allowed us to determine each patient's methadone dose, take home status, and hospitalization status for every day they were enrolled in MMT during the study period. By including subjects with a documented primary care physician and a signed release of information, our sample allowed for documentation of medical problems through the EMR at the affiliated medical center. While this inclusion criterion limited the proportion of eligible patients included in the analysis and limits the generalizability of our findings, it is unlikely this would bias the results, because engagement in primary care likely decreases acute care utilization. This study was also limited by the nature of retrospective design and focus on a single clinic.

However, because methadone maintenance treatment is subject to federal regulations, there are substantial similarities from clinic to clinic.

CONCLUSIONS

Among MMT patients, receipt of take homes, but not dose of methadone, was significantly associated with reduced medical hospitalizations. Thus, take home status reflects not only patients' improved addiction outcomes, but also reduced healthcare utilization. Given that this characteristic is easy to measure, clinically important, and has cost implications, it may have implications for addiction and medical treatment and cost, it should be further considered as a useful quality and performance measure for MMTs. Furthermore, intervention studies that seek to increase take home status among MMT patients' should evaluate healthcare utilization outcomes.

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List of References

- Center for Substance Abuse Treatment. Treatment Improvement Protocol (TIP) Series 43. Rockville, MD: Substance Abuse and Mental Health Services Administration; 2005. Medication-Assisted Treatment for Opioid Addiction in Opioid Treatment Programs. DHHS Publication Number (SMA) 05-4048
- Chutua MA, Silverman K, Stitzer ML. Effects of urine testing frequency on outcome in a methadone take-home contingency program. *Drug Alcohol Depend.* 2001; 62:69–76. [PubMed: 11173169]
- Chutua MA, Silverman K, Stitzer ML. Use of methadone take-home contingencies with persistent opiate and cocaine abusers. *J Subst Abuse Treat.* 1999; 16:23–30. [PubMed: 9888118]
- D'Aunno T, Pollack HA. Changes in methadone treatment practices: results from a national panel study, 1988-2000. *JAMA.* 2002; 288:850–856. [PubMed: 12186602]
- Faggiano F, Vigna-Taglianti F, Versino E, Lemma P. Methadone maintenance at different dosages for opioid dependence. *Cochrane Database Syst Rev.* 2003
- Friedmann PD, Hendrickson JC, Gerstein DR, Zhang Z, Stein MD. Do mechanisms that link addiction treatment patients to primary care influence subsequent utilization of emergency and hospital care? *Med Care.* 2006; 44:8–15. [PubMed: 16365607]
- Gourevitch MN, Chatterji P, Deb N, Schoenbaum EE, Turner BJ. On-site medical care in methadone maintenance: associations with health care use and expenditures. *J Subst Abuse Treat.* 2007; 32:143–151. [PubMed: 17306723]
- Kidorf M, Stitzer ML, Brooner RK, Goldberg J. Contingent methadone take-home doses reinforce adjunct therapy attendance of methadone maintenance patients. *Drug Alcohol Depend.* 1994; 36:221–226. [PubMed: 7889813]
- Laine C, Lin YT, Hauck WW, Turner BJ. Availability of medical care services in drug treatment clinics associated with lower repeated emergency department use. *Med Care.* 2005; 43:985–995. [PubMed: 16166868]
- Laine C, Hauck WW, Gourevitch MN, Rothman J, Cohen A, Turner BJ. Regular Outpatient Medical and Drug Abuse Care and Subsequent Hospitalization of Persons Who Use Illicit Drugs. *JAMA.* 2001; 285:2355–2362. [PubMed: 11343483]
- Lugo RA, Satterfield KL, Kern SE. Pharmacokinetics of methadone. *J Pain Palliat Care Pharmacother.* 2005; 19:13–24. [PubMed: 16431829]
- National Consensus Development Panel on Effective Medical Treatment of Opiate, Addiction. Effective Medical Treatment of Opiate Addiction. *JAMA.* 1998; 280:1936–1943. [PubMed: 9851480]

- Office of National Drug Control Policy, 2010. National Drug Control Strategy. 2010
- Parthasarathy S, Mertens J, Moore C, Weisner C. Utilization and cost impact of integrating substance abuse treatment and primary care. *Med Care*. 2003; 41:357–367. [PubMed: 12618639]
- Peles E, Schreiber S, Adelson M. 15-Year survival and retention of patients in a general hospital-affiliated methadone maintenance treatment (MMT) center in Israel. *Drug Alcohol Depend*. 2010; 107:141–148. [PubMed: 19914783]
- Peles E, Schreiber S, Sason A, Adelson M. Earning “take-home” privileges and long-term outcome in a methadone maintenance treatment program. *J Addict Med*. 2011; 5:92–98. [PubMed: 21769054]
- Pollack HA, D’Aunno T. Dosage patterns in methadone treatment: results from a national survey, 1988-2005. *Health Serv Res*. 2008; 43:2143–2163. [PubMed: 18522665]
- Strain EC, Bigelow GE, Liebson IA, Stitzer ML. Moderate- vs high-dose methadone in the treatment of opioid dependence: a randomized trial. *JAMA*. 1999; 281:1000–1005. [PubMed: 10086434]
- Weisner C, Mertens J, Parthasarathy S, Moore C, Lu Y. Integrating primary medical care with addiction treatment: a randomized controlled trial. *JAMA*. 2001; 286:1715–23. [PubMed: 11594896]

Figure 1.
Identification of study sample among methadone maintenance treatment patients

Table 1

Subject Characteristics at study enrollment (n=138)

	Total n=138	Take homes ever n=72 (52%)	Never take homes n=66 (48%)	p-value	Dose < 80mg always n=35 (25%)	Dose 80 mg ever n=103 (75%)	p-value
	n (%)	n (%)	n (%)		n (%)	n (%)	
Male	66 (48)	39 (54)	27 (41)	0.1	14 (40)	52 (50)	0.3
Race/Ethnicity				0.3			0.6
Non-Hispanic White	68 (49)	34 (47)	34 (52)		17 (49)	51 (50)	
Non-Hispanic Black	40 (29)	19 (26)	21 (32)		12 (34)	28 (27)	
Hispanic	30 (22)	19 (26)	11 (17)		6 (17)	24 (23)	
HIV Infection	23 (17)	13 (18)	10 (15)	0.6	4 (11)	19 (18)	0.3
Medical Illness	44 (32)	26 (36)	18 (27)	0.3	10 (29)	34 (33)	0.6
Mental Illness	55 (40)	27 (38)	28 (42)	0.6	8 (23)	47 (46)	0.02
Polysubstance Use	72 (52)	31 (43)	41 (62)	<0.01	12 (34)	60 (58)	0.01
	Mean (SD)	Mean (SD)	Mean (SD)		Mean (SD)	Mean (SD)	
Age	43 (11.5)	46 (11.4)	39 (10.5)	<0.01	42 (12.4)	43 (11.2)	0.8
Mean Dose	85 (30.9)	90 (33.1)	80 (27.7)	0.06	50 (12.9)	97 (26.0)	<0.01
Follow-up-months	20 (8.0)	23 (5.2)	16 (9.0)	<0.01	17 (9.6)	21 (7.1)	0.02
Months in treatment before study	39 (54.7)	60 (64.9)	17 (27.4)	<0.01	47 (67.3)	37 (49.9)	0.4

Table 2

Multivariate Nonlinear Mixed Effects Logistic Regression Model Evaluating Association between Take Home Status, Methadone Dose and Hospital Admission (n=138)

	Adjusted Odds Ratio	95% Confidence Interval	p-value
Take Home Status	0.26	0.11 -0.62	<0.01
Dose 80mg	1.01	0.56-1.83	0.97
Age (per 1 year)	1.01	0.97-1.05	0.70
Female	Ref		
Male	1.25	0.64-2.44	0.51
Race/Ethnicity			
White	Ref		
Black/African American	0.67	0.29-1.52	0.33
Hispanic	0.73	0.31-1.72	0.47
HIV	1.77	0.82-3.81	0.14
Medical Illness	2.41	1.20-4.85	0.01
Mental Illness	0.61	0.31-1.22	0.16
Polysubstance Use	1.28	0.63-2.61	0.49

Model also adjusted for follow-up time as a time-varying covariate and months in treatment before study

Table 3**Primary Diagnoses for Hospitalizations of Methadone Maintenance Patients**

	N=80	%
Pneumonia or upper respiratory infection	11	13.8%
Cardiac (Chest pain, arrhythmia)	9	11.2%
Gastrointestinal (pancreatitis, diverticulitis, melena, abdominal pain, biliary obstruction)	8	10%
Other infection (viral, bacteremia, urinary tract, osteomyelitis)	7	8.8%
Asthma or chronic obstructive pulmonary disease exacerbation	6	7.5%
Trauma or musculo-skeletal pain	6	7.5%
Psychiatric	5	6.2%
Diabetes	4	5%
Soft tissue infection (cellulitis)	3	3.8%
Renal failure	2	2.5%
Altered mental status (delirium, encephalopathy)	2	2.5%
Paralysis Agitans	1	1.2%
Spontaneous ecchymosis	1	1.2%
Detoxification	1	1.2%
Release from incarceration	1	1.2%
Unknown	13	16.2%