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Inpatient addiction consultation and post-discharge 30-day acute care utilization

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Abstract

Background—Addiction Consult Services care for hospitalized patients with substance use disorders (SUD), who frequently utilize costly medical services. This study evaluates whether an addiction consult is associated with 30-day acute care utilization.

Methods—This was a retrospective cohort study of 3905 inpatients with SUD. Acute care utilization was defined as any emergency department visit or re-hospitalization within 30 days of discharge. Inverse probability of treatment weighted generalized estimating equations logistic regression models were used to evaluate the relationship between receipt of an addiction consult and 30-day acute care utilization. Exploratory subgroup analyses were performed to describe

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whether this association differed by type of SUD and discharge on medication for addiction treatment.

Results—The 30-day acute care utilization rate was 39.5% among patients with a consult and 36.0% among those without. Addiction consults were not significantly associated with care utilization (Adjusted Odds Ratio 1.02; 0.82, 1.28). No significant differences were detected in subgroup analyses; however, the decreased odds among patients with OUD given medication was clinically notable (AOR 0.69; 0.47, 1.02).

Discussion—Repeat acute care utilization is common among hospitalized patients with SUD, particularly those seen by the addiction consult services. While this study did not detect a significant association between addiction consults and 30-day acute care utilization, this relationship merits further evaluation using prospective studies, controlling for key confounders and with a focus on the impact of medications for opioid use disorder.

Keywords

Consult service; Substance use disorder; Care utilization; Hospital readmission; Medication for addiction treatment

1. Introduction

The United States of America is in the midst of an overdose epidemic. (Jones CM et al., 2013; Rudd et al., 2016; Volkow et al., 2014) Despite the increased public attention to substance use disorders (SUD), less than a quarter of the 20 million Americans with SUD received any treatment in 2017.(Substance Abuse and Mental Health Services Administration, 2018) Barriers to SUD care include lack of patient and provider awareness of evidence-based treatment options, lack of integration of addiction care into mainstream medicine and stigma.(Appel et al., 2004; Appel and Oldak, 2007; Drainoni et al., 2014; Noska et al., 2015; Walley et al., 2008; Yarborough et al., 2016) Even hospitalized patients with active co-morbid SUD do not routinely have their SUD addressed by the inpatient care team, contributing to increased costs and readmission risk (Baser et al., 2011; Lynch et al., 2014; Walley et al., 2012). In 2016 there were 657,000 hospital admissions in the USA with a substance use disorder as the primary diagnosis, with a total medical cost of $5.2 billion, which does not account for other societal costs such as lost productivity.(Agency for Healthcare Research and Quality, 2019) SUD are also highly prevalent in hospitals, with nearly one fifth of all hospitalized patients having a substance use disorder as a primary or secondary diagnosis. (Center for Health Information And Analysis, 2016; Walley et al., 2012)

Patients with substance use are more likely to frequently utilize inpatient services (Bell et al., 2017; Robinson et al., 2016; Wu et al., 2018) and have preventable readmissions. (Goldfield et al., 2008; Gupta et al., 2018; McIntyre et al., 2016) Infectious complications from injection drug use are also on the rise, driving increased care utilization among people with SUD.(Gray et al., 2018) Some evidence suggests that addressing substance use during hospitalization can improve care utilization after leaving the hospital.(Baser et al., 2011; Lynch et al., 2014; Smith-Bernardin et al., 2018; Wei et al., 2015)

An Addiction Consult Service (ACS) is a multi-disciplinary consultation team with addiction expertise that takes advantage of the reachable moment of a hospitalization to diagnose patients with SUD, counsel them about treatment options, coach and collaborate with inpatient providers, initiate evidence-based medications for addiction and bridge patients to long-term outpatient treatment.(Priest and McCarty, 2019; Shanahan et al., 2010; Weinstein et al., 2018) This model of care is rapidly expanding, but is still relatively new. Therefore, the effectiveness of these real-world interventions on post-discharge care utilization has not been well described. One recent study showed decreases in self-reported care utilization among patients who had received an addiction consult.(Wakeman et al., 2017) A second study showed decreased 90-day readmissions for a subset of patients with a serious infection secondary to drug use requiring long-term antibiotics. (Marks et al., 2019) However, another study did not show an impact of an ACS on care utilization in a retrospective chart review.(Nordeck et al., 2018)

The primary aim of this study was to evaluate whether an addiction consult is associated with acute care utilization, including emergency department and inpatient admissions, within 30 days of discharge among patients with SUD. An exploratory aim of this study was to evaluate whether the impact of an addiction consult differed by the type of SUD and/or the receipt of medications for addiction treatment.

2. Materials and Methods

2.1. Patients and admissions

The INREACH (INpatient REadmission post-Addiction Consult Help) Study was a retrospective cohort study of all admitted non-pregnant adult patients with a SUD diagnoses from July 2015 to July 2016 at Boston Medical Center, a large urban safety net hospital. Primary and secondary discharge diagnosis codes were used to identify patients with SUD. Types of SUD diagnoses included opioid, cocaine, alcohol, cannabis, sedative and stimulant. The sample included both inpatient admissions and observation-status admissions. A single patient could contribute multiple admissions. For a given admission (either inpatient or observation), a patient was considered to be in the exposed group if he or she received an addiction consult during that admission, as documented by a note from the ACS and confirmed by manual chart review by a trained medical student (M.D.).

2.2. Measures

Basic demographics, medical diagnoses, admission characteristics and administered medications were abstracted from the Electronic Medical Record. Demographics included age, sex, race/ethnicity, insurance type, and housing status. Admission characteristics included the admitting service, length of stay, whether Intensive Care Unit or Psychiatry consult was required and whether the patient left against medical advice (AMA). Medical and substance use characteristics included HIV status, types of SUD and number of SUD, whether naloxone was administered or an overdose occurred, acute complications of substance use (e.g. seizure, endocarditis), whether the patient was receiving buprenorphine or methadone as an outpatient, if the Clinical Opiate Withdrawal Scale (COWS) was used and if the patient received inpatient buprenorphine, methadone, benzodiazepines

or phenobarbital. Medications for addiction treatment on discharge were also recorded, including the start or continuation of methadone, buprenorphine, naltrexone, acamprosate, disulfiram or topiramate, as these were the common medications recommended by the ACS. (Trowbridge et al., 2017)

2.2.1 Main independent variable and primary outcome—The main independent variable was whether or not the patient received an addiction consult during the given encounter. The primary outcome was any 30-day post discharge acute care utilization, measured as either an emergency department visit or a new admission (inpatient or observation) within 30 days of discharge from the index admission. This care utilization was not limited to SUD-related admissions.

2.3 Statistical analyses

Descriptive statistics were calculated including frequencies and percentages of categorical variables and means, standard deviations, medians, 25th and 75th percentiles for continuous variables. To address potential confounding, inverse probability of treatment weighted (IPTW) generalized estimating equations (GEE) logistic regression models were used to examine the relationship between receipt of consultation from the ACS and 30-day acute care utilization. The GEE model accounts for the correlation due to including multiple admissions ***from individual patients.*** The models were fit using a logit link and an autoregressive working correlation structure. Robust empirical standard errors are reported.

Weights were derived from propensity score modeling of receipt of consultation from the ACS as a function of potential confounders. To estimate the propensity of having an addiction consult in a given admission, a longitudinal GEE regression model was fit using receipt of an addiction consult as the outcome of the model. We included in this model several demographic, admission, substance use and medical characteristics (Table 1) as they were considered potential confounders of the association between acute care utilization and an addiction consult. These variables, listed in the Measures section, were selected a priori based on current literature and guided by clinical experience of the authors.(Chuang et al., 2017; D'Amico et al., 2019; McIntyre et al., 2016; Nordeck et al., 2018; Wei et al., 2015; Wu et al., 2018) Spearman correlation coefficients were calculated between independent variables to assess potential collinearity. No pair of variables included in the models had correlation >0.50.

The resulting model calculated the predicted probability of having an addiction consult (i.e., the propensity score for each patient encounter). To assess for balance in covariates, descriptive statistics for each covariate by exposure group (ACS consult yes vs. no) were reviewed for the unweighted and weighted samples. (Table 1) The propensity scores were then incorporated into the analyses using IPTW logistic regression models and robust standard errors were reported. Due to large weights in the data we truncated conventional weights at the 99th percentile.(Austin and Stuart, 2015) We also performed sensitivity analyses including stabilized weights (i.e. conventional weights multiplied by marginal probability of receiving given exposure), both without truncation and truncated at a value of 10.(Robins et al., 2000; Stürmer et al., 2014) We performed an additional sensitivity analysis

to explore the impact of variables of unknown temporality included in the propensity score, specifically variables that could have occurred before or as a consequence of an addiction consult (e.g. the ordering of methadone during the admission).

2.3.1. Exploratory analyses—Pre-planned exploratory analyses were performed to describe the association between the receipt of a consult from the ACS and any post-discharge 30-day acute care utilization stratified by type of SUD diagnosis (opioid vs non-opioid). In addition, we hypothesized that a major impact of the addiction consult would be through medications (specifically medications for opioid use disorder). Thus, we conducted an additional analysis stratified by a 4-category effect modifier: 1) Opioid use disorder (OUD) and medication started/continued; 2) OUD and no medication started/continued; 3) non-OUD and medication started/continued; and 4) non-OUD and no medication started/continued. For these analyses we re-ran the propensity score analysis, excluding the OUD and medication variables as these were used for stratification. We performed all analyses using SAS version 9.4 (SAS Institute, Inc., NC, USA). This study was approved by the Boston University Medical Campus Institutional Review Board.

3. Results

There were 5979 total admissions for 3905 unique patients with SUD during the study period. An addiction consult was performed in only 694 (11.6%) of these visits. The demographics of the patients who received a consult, as compared with those who did not, have been previously described.(D'Amico et al., 2019) In brief, the following patient characteristics were associated with higher odds of receiving an addiction consult: opioid use disorder, acute complications from substance use, homelessness, and HIV infection. Older patients and those with an overdose diagnosis had lower odds of receiving a consult. As shown in Table 1, the inverse probability of treatment weighted (IPTW) method using the propensity score improved balance compared with the unweighted sample for several covariates. (Table 1)

3.1. Primary analysis: 30-day acute care utilization

The repeat 30-day acute care utilization rate was 39.5% (274/694) among those encounters with an addiction consult and 36.0% (1902/5285) among those encounters without a consult (Unadjusted Odds Ratio 1.16; 95% CI 0.98-1.38). In adjusted analyses, an addiction consult was not statistically significantly associated with 30-day acute care utilization among SUD patient encounters (Adjusted Odds Ratio 1.02; 0.82, 1.28). (Table 2) We performed three sensitivity analyses to confirm the main findings, the first two included: i) using stabilized weights and ii) using stabilized weights truncated at a value of 10. A third sensitivity analysis explored the impact of variables included in the original propensity model whose temporality were unknown and may in fact have been a result of an addiction consult. Specifically we excluded the following variables from the propensity score: COWS, methadone during admission, buprenorphine during admission, and benzodiazepine or barbiturate during admission. The conclusions from these sensitivity analyses were consistent with the main analysis. (Appendix 1)

3.2. Exploratory analyses: assessment of whether results differ by opioid use disorder (OUD) and medication for addiction treatment

Among 2163 admissions for patients with OUD, 952 (44.0%) received medication for addiction treatment on discharge. Overall, 3816 admissions for patients with a non-opioid use disorder occurred and of those 353 (9.3%) received medication for addiction treatment on discharge.

The 30-day acute care utilization rate for encounters with OUD was 41.7% (901/2163). The 30-day acute care utilization rate for encounters without OUD was 33.4% (1275/3816). Among the subgroup of patients with OUD, those who received a consult had a 13% decreased odds of any 30-day utilization (AOR 0.87; 0.66, 1.13) compared with those without an addiction consult, whereas among the subgroup of patients without OUD, those who received a consult had a 6% increased odds (AOR 1.06; 0.74, 1.52) compared with patients without an addiction consult. Neither result was statistically significant. (Table 2)

We then further stratified analyses by using the 4-category variable of opioid use disorder (OUD) and medication for addiction treatment. These generated the following adjusted odds ratios representing the association between receipt of ACS and 30-day acute care utilization: among patients with OUD and given medication, AOR 0.69 (CI 0.47, 1.02); among patients with OUD and without medication, AOR 1.06 (0.73, 1.53); among patients without OUD and given medication, AOR 1.09 (0.62, 1.90); and among patients without OUD and not given medication, AOR 0.83 (0.50, 1.38); within each of these 4 subgroups, the comparison of interest is receipt of an addiction consult compared with no addiction consult. (Table 2)

4. Discussion

Subsequent acute care utilization is common among hospitalized patients with SUD, particularly those who were referred to the ACS. This study found very high rate 30-day acute care utilization for patients with SUD overall: 39.5% for those with a consult and 36% for those not seen by the consult service. A similar study in a Maryland hospital found the 30-day readmission rate to be 13.9%.(Nordeck et al., 2018) That study did not include emergency department visits in its outcome, and emergency department utilization has been shown to be very high among patients with SUD.(Nambiar et al., 2018) Thus, the composite outcome used in this study - which includes both emergency department visits and re-hospitalization - may be a measure that is even more challenging to impact with an intervention such as an ACS. The patients also had substantial medical comorbidities with at least a quarter of admissions requiring intensive care, and over a third with significant medical complications of substance use. In an attempt to mitigate such confounding, both of these variables were controlled for in the propensity score analyses. In addition, as this was the first year of the ACS's existence in this hospital, an addiction consult was a relatively uncommon event, with only one-fifth of primary SUD admissions involved an addiction service consult. This was new service and its early implementation may not have demonstrated the full potential of the ACS to efficiently and effectively deliver care and impact outcomes.

We hypothesized that the major impact of the ACS would be through the initiation of medications for addiction treatment, especially for patients with OUD. For the subset of patients with OUD who started or continued on medication, the odds of 30-day acute care utilization appeared to decrease by 31 % for those with receipt of ACS compared with those who did not. These findings, while not statistically significant, are in line with literature demonstrating that medications for OUD are associated with decreased hospitalizations and emergency department visits. However, prior studies demonstrating decreased care utilization among patients on medications for OUD included patients who engaged in outpatient buprenorphine treatment and remained in treatment for 12 months (Lo-Ciganic et al., 2016), or methadone maintenance patients in the first two years of treatment.(Russolillo et al., 2019) In this current study we grouped patients together who continued or initiated medication during the hospitalization because we were not able to distinguish them in the data. Presumably patients who newly initiated medications were more unstable in their recovery and overall than those continuing medications. Likely the vast majority of newly started medications were among patients seen by the ACS. Thus, grouping these patients may mitigate some of the impact of the ACS as ACS encounters for patients newly started medication were compared with encounters for patients who were more likely stable on medication and not seen by the ACS. Furthermore, we were not able to capture or explore the impact of duration of medication continuation after discharge. The medical complexity, social instability and limited treatment readiness of patients who are hospitalized and then offered addiction treatment makes this population quite distinct from patients who self-refer, engage and remain in long-term outpatient OUD treatment. However, a great strength of addiction consult teams is their ability to initiate medication for addiction treatment and link patients to long-term treatment. This increases the likelihood that hospitalized patients will reap the benefits of medications, which are associated with decreased morbidity and mortality.(Englander et al., 2019)

There are a myriad of pressures on hospitals to reduce readmissions.(Chokshi and Chang, 2014) Some hospital-based interventions have been shown to improve readmission rates, (Feltner et al., 2014; Gallagher et al., 2017) but others do not perform consistently. For example, a recent study of inpatient infectious disease consultation demonstrated decreased readmissions for some types of bacterial infections and not others.(Burnham et al., 2018) Because this is an observational study, consultants may be more likely to be called in for complex cases. This is similar to a study of heart failure patients, which found that a palliative care consultation increased 30-day readmission rates. The authors of that study attributed this to unmeasured confounders of disease severity and social determinants of health.(Chuang et al., 2017) There are likely some unmeasured confounders for which we were not able to fully account, given the data were collected retrospectively for clinical purposes. For example, social determinants of health including income, marital status and dependent children have large impact on readmission rates.(Meddings et al., 2017) Many of these variables were not available from the medical record in this retrospective study. Prior work has shown that OUD patients have higher rates of readmission. This may not be due to OUD alone, but could also be due to unmeasured confounders. (Nordeck et al., 2018)

The ACS was neither designed nor staffed to explicitly address acute care utilization. At the time of this study, the team consisted of only physicians assisted by one part-time

nurse focusing on methadone linkage.(Trowbridge et al., 2017) The primary focus of the service was to provide harm reduction services and offer medications for SUD. More recent versions of the ACS, and other models around the country, include explicit use of peer recovery coaches, social workers and other staff. These additional team members are able to follow patients post-discharge and link patients to a wider array of outpatient services, which may be more likely to impact acute care utilization.(Collins et al., 2019; Weinstein et al., 2018)

The existence of the ACS itself may increase readmissions by creating a culture change in the hospital overall, making it a more welcoming and supportive place for patients with SUD, leading them to feel more comfortable returning, thus increasing readmissions. Notably, there was a high rate of AMA discharges among patients in this study (11.5% for those seen by ACS and 8.5% for those not seen). This is not surprising as AMAs are common among patients with SUD, especially those with OUD.(Lail and Fairbairn, 2018; McNeil et al., 2014; Ti and Ti, 2015; Zhu and Wu, 2019) In addition, while the ACS actively works to manage patients' symptoms in the hospital and connect them to outpatient care, patients with SUD may also be at higher risk of readmission due to inability to receive appropriate medical care post-discharge. For example, many skilled nursing facilities are unwilling to accept patients with SUD.(Wakeman and Rich, 2017) Furthermore, concerns for a patient leaving AMA can be a reason for seeking an addiction service consult, which may contribute to this finding.

4.1 Strengths and Limitations

This study's strengths included the use of propensity score analyses to minimize the confounding inherit in observational studies and to better estimate the heterogenous effect of an addiction consult. (D'Agostino, 1998) Another strength is the specific examination of the impact of providing medications in the hospital on post-discharge care utilization.

This study has some additional limitations. This includes our inability to capture acute care utilization at other hospitals, many of which are available in the metro Boston area.(Burke et al., 2018; Davies et al., 2013) Details about post-discharge addiction treatment engagement and retention were also not available for inclusion. Use of the propensity score analysis was a study strength; nonetheless, it may not have adequately controlled for confounding by all variables. Specifically, there may be residual confounding from variables such as whether benzodiazepines or barbiturates were ordered during admission, admitting service, type of SUD, and HIV status. For these variables, imbalance between groups remained even after propensity score adjustment (reflected in the standardized differences >.20 for these variables).(Ali et al., 2014; Austin and Stuart, 2015; Brooks and Ohsfeldt, 2013; D'Agostino, 1998) (Table 1) Also, as a consult service, the ACS does not submit any orders, but instead makes recommendations to the primary team. Some of the variables in the propensity score had an unknown temporality. For example, it is unknown whether the use of methadone in the hospital was in fact a recommendation by the ACS team or initiated prior to the consult by the primary team. However, the sensitivity analysis that removed the variables of unknown temporality was consistent with the main finding. In addition, there is still potential for unmeasured confounders, including confounding by indication related

to the severity of SUD, and social determinants of health, which could impact readmission. (Brooks and Ohsfeldt, 2013) Although the overall sample size was large, this study may have been underpowered within the subgroup analyses to detect the impact of medications and type of SUD. A larger study over a longer period may be better able to capture the impact of an addiction consult service.

5. Conclusion

Repeat acute care utilization is common among hospitalized patients with SUD, including those who were referred to the addiction consult service. In adjusted analyses we did not detect a significant association between receipt of an addiction consult and 30-day acute care utilization. Our exploratory analyses suggest any impact of these services may be larger on patients with opioid use disorder who were started or continued on medications for addiction treatment. Addiction consult teams should recognize the possible impact of initiating medications for opioid use disorder and consider other specific interventions to decrease acute care utilization. Future research should include prospective studies designed to control for key confounders which are difficult to measure retrospectively, and should further examine the benefits of medications for substance use disorders.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights:

- Acute care utilization is common among patients with substance use disorders
- No significant association between addiction consults and 30-day care utilization
- Impact of medication for opioid use disorder on healthcare utilization merits further study

Table 1.

Characteristics of inpatients with a substance use disorder who did and did not receive an addiction consult used to calculate the propensity of receiving an addiction consult (July 2015 – July 2016), including unweighted and weighted standardized differences

		Unweighted sample (and N)*				Weighted sample[a]*		
Variable	**Measure, %(N)**	**Consult N= 436**	**No Consult N= 3469**	**Standardized Difference[b]**		**Consult N= 436**	**No Consult N= 3469**	**Standardized Difference[b]**
Basic demographics								
Age	Mean (Std Dev) Median (25th, 75th)	43.0 (12.2) 43.0 (32, 53)	49.6 (14.6) 51.0 (39, 59)	0.49		47.2 (30.0) 49.0 (38, 56)	48.9 (15.4) 50.0 (38, 59)	0.07
Sex	Male	68.3% (298)	70.7% (2451)	0.05		67.5%	70.9%	0.07
	Female	31.7% (138)	29.3% (1018)	0.05		32.5%	29.1%	0.07
Race/ethnicity	White	51.4% (224)	40.1% (1391)	0.23		46.7%	41.8%	0.10
	African American	26.1% (114)	38.9% (1351)	0.28		32.3%	37.4%	0.11
	Latino	19.3% (84)	16.6% (577)	0.07		17.7%	16.7%	0.03
	Other	2.8% (12)	3.6% (126)	0.05		3.0%	3.5%	0.03
	Asian	0.5% (2)	0.7% (24)	0.03		0.2%	0.7%	0.06
Insurance status	Medicaid	73.2% (319)	55.6% (1928)	0.37		64.6%	57.3%	0.15
	Medicare	16.3% (71)	24.9% (863)	0.21		18.7%	24.0%	0.13
	Private	8.7% (38)	15.9% (551)	0.22		12.8%	15.3%	0.07
	Uninsured	1.8% (8)	3.7% (127)	0.11		3.9%	3.4%	0.02
Homeless		38.1% (166)	22.3% (772)	0.35		29.7%	24.0%	0.13
Admission characteristics								
Admitting Service	General and Family Medicine	61.7% (269)	45.2% (1567)	0.34		58.6%	46.2%	0.25
	Medical Subspecialties	11.2% (49)	10.7% (372)	0.02		10.5%	10.9%	0.01
	General Surgery and Surgical Subspecialties	8.9% (39)	22.2% (771)	0.37		14.0%	20.8%	0.18
	Intensive Care Unit	16.7% (73)	9.9% (342)	0.20		14.5%	11.2%	0.10
	Other[c]	1.4% (6)	12.0% (417)	0.44		2.4%	10.9%	0.35
Length of stay	Mean (Std Dev) Median (25th, 75th)	5.9 (6.9) 3.6 (2, 7)	4.1 (7.4) 2. (1, 4)	0.25		5.3 (13.2) 3.5 (2, 7)	4.5 (9.3) 2.2 (1, 5)	0.07
ICU stay during admission[d]		25.9% (113)	19.6% (681)	0.15		24.6%	20.9%	0.09

		Unweighted sample (and N)*				Weighted sample[a]*		
Variable	**Measure, %(N)**	**Consult N= 436**	**No Consult N= 3469**	**Standardized Difference[b]**		**Consult N= 436**	**No Consult N= 3469**	**Standardized Difference[b]**
Psychiatry consulted during admission		22.7% (99)	11.8% (408)	0.29		16.5%	13.7%	0.08
Discharged against medical advice		11.5% (50)	8.5% (295)	0.10		11.5%	8.9%	0.09
Medical and substance use characteristics								
HIV Positive		19.3% (84)	6.5% (226)	0.39		17.1%	7.6%	0.29
Type of substance use disorder[e]	Non-Opioid	21.8% (95)	71.8% (2492)	1.16		48.8%	66.9%	0.37
	Opioid Only	24.3% (106)	16.0% (555)	0.21		24.7%	16.6%	0.20
	Opioid and Other Use Disorder	53.9% (235)	12.2% (422)	0.99		26.6%	16.5%	0.25
Number of substance use disorder diagnoses	Mean (Std Dev) Median (25th, 75th)	1.9 (1.0) 2.0 (1, 2)	1.3 (0.6) 1.0 (1, 1)	0.78		1.5 (2.0) 1.0 (1, 2)	1.4 (0.7) 1.0 (1, 2)	0.11
Naloxone administered		3.2% (14)	1.5% (51)	0.12		3.2%	1.7%	0.09
Overdose diagnosis		10.8% (47)	7.1% 9247)	0.13		6.6%	8.0%	0.05
Acute complications[g]		57.1% (249)	35.3% (1224)	0.45		43.6%	37.9%	0.11
COWS ordered[e]		33.0% (144)	2.9% (102)	0.85		9.8%	5.8%	0.15
Outpatient methadone		3.0% (13)	2.2% (78)	0.05		3.5%	2.4%	0.07
Outpatient buprenorphine		6.2% (27)	2.6% (90)	0.18		4.5%	3.2%	0.07
Methadone ordered during admission[e]		49.3% (215)	8.6% (300)	1.00		17.9%	12.8%	0.14
Buprenorphine ordered during admission[e]		11.5% (50)	4.3% (150)	0.27		6.1%	5.4%	0.03
Benzodiazepines/barbiturates ordered during admission		48.4% (211)	35.9% (1244)	0.26		50.8%	37.6%	0.27

Legend

*All analyses performed reflect patient-level analyses

[a]weights are truncated at 99th percentile due to large weights

[b]The standardized difference was calculated as the difference in means (or proportions) divided by the pooled standard deviation

[c]Other services include Neurology, Gynecology, Pediatrics, Unknown

[d]Patient stayed at least one day in the Intensive Care Unit during admission

[e]Denotes variables removed from propensity score for secondary analysis of effect modification

[f]Acute complications include: cellulitis/abscess, osteomyelitis, tenosynovitis, endocarditis, acute and chronic pancreatitis, delirium tremens, acute and chronic pancreatitis, seizures and Wernicke-Korsakoff Syndrome

[g]Clinical Opiate Withdrawal Scale ordered during admission

Table 2.

Unadjusted and adjusted association between Addiction Consult Service (ACS) and 30-day acute care utilization

	Unadjusted OR (95% CI)*	Adjusted OR (95% CI)*
Primary Analysis		
Full Sample (N=3905 unique subjects, 5979 total observations)	1.16 (0.98, 1.38)	1.02 (0.82, 1.28)
Exploratory Subgroup Analyses		
With OUD (N=1378 unique subjects, 2163 observations)	0.98 (0.79, 1.20)	0.87 (0.66, 1.13)
With OUD and medication (N=631 unique subjects, 952 observations)	0.83 (0.61, 1.12)	0.69 (0.47, 1.02)
With OUD without medication (N=850 unique subjects, 1211 observations)	1.16 (0.87, 1.55)	1.06 (0.73, 1.53)
Without OUD (N = 2654 unique subjects, 3816 observations)	1.04 (0.75, 1.44)	1.06 (0.74, 1.52)
Without OUD with medication (N = 249 unique subjects, 353 observations)	1.05 (0.64, 1.73)	1.09 (0.62, 1.90)
Without OUD without medication (N = 2476 unique subjects, 3463 observations)	0.84 (0.53, 1.34)	0.83 (0.50, 1.38)

Legend

*All analyses performed reflect represent encounter-level analyses

OUD – Opioid Use Disorder

Medication – continued or started during admission, including the medications methadone, buprenorphine, naltrexone, acamprosate, disulfiram ortopiramate

Adjusted OR - represents an inverse probability of treatment weighting generalized estimating equation logistic model with weights truncated at 99th percentile, and includes the following variables in the propensity score: age, sex, race/ethnicity, insurance status, housing status, length of stay, ICU stay during admission, psychiatry consult during admission, discharge against medical advice, HIV status, types of substance use disorder[a], number of substance use disorders, naloxone administered, overdose diagnosis, acute complications, COWS ordered, outpatient methadone or buprenorphine, methadone or buprenorphine ordered during admission[a], benzodiazepine or barbiturate ordered during admission

[a]Denotes variables removed from propensity score for secondary analysis of effect modification