Addiction Consult Service and Inpatient Outcomes Among Patients with Alcohol Use Disorder

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ABSTRACT

BACKGROUND: Alcohol use disorder (AUD) is the most prevalent substance use disorder, but evidence-based medications to treat AUD (MAUD), including naltrexone and acamprosate, are substantially underutilized. Hospitalization provides an opportunity to start MAUD for patients who may not otherwise seek treatment. Addiction consultation services (ACSs) have been increasingly utilized to ensure appropriate treatment. There is little research examining the effect of an ACS on health outcomes among patients with AUD.

OBJECTIVE: To determine the association between an ACS consultation and provision of MAUD during admission and MAUD at discharge among admissions with AUD.

DESIGN: Retrospective study comparing admissions which received an ACS consult and propensity score–matched historical control admissions.

Subjects

A total of 215 admissions with a primary or secondary diagnosis of AUD who received an ACS consult and 215 matched historical control admissions.

Intervention

ACS consultation from a multidisciplinary team offering withdrawal management, substance use disorder treatment, patient-centered counseling, discharge planning, and linkage to outpatient care for patients with substance use disorders, including AUD.

Main Measures

Primary outcomes were initiation of new MAUD during admission and new MAUD at discharge. Secondary outcomes were patient-directed discharge, time to 7- and 30-day readmission, and time to 7- and 30-day post-discharge ER visit.

Key Results

Among 430 admissions with AUD, those that received an ACS consultation were significantly more likely to receive new inpatient MAUD (33.0% vs 0.9%; OR 52.5 [CI 12.6–218.6]) and significantly more likely to receive new MAUD at discharge (41.4% vs 1.9%; OR 37.3 [13.3–104.6]), compared with historical controls. ACS was not significantly associated with patient-directed discharge, time to readmission, or time to post-discharge ER visit.

CONCLUSIONS: ACS was associated with a large increase in provision of new inpatient MAUD and new MAUD at discharge when compared to propensity-matched historical controls.

Keywords: Alcohol-related disorder; Alcohol use disorder; Hospitalization; Substance use treatment; Addiction consult

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INTRODUCTION

Alcohol use disorder (AUD) has a lifetime prevalence of 29% nationally, making it the most common substance use disorder (SUD) in the USA.[1] AUD is responsible for an estimated 100,000 deaths annually[2] and 28 billion dollars spent on alcohol-related morbidity annually in the USA.[3] Excessive alcohol use can cause diseases of the gastrointestinal, cardiac, pulmonary, and immune systems, as well as psychiatric disorders.[4]

There are three FDA-approved medications for the treatment of AUD (MAUD): naltrexone, acamprosate, and disulfiram.[5] Disulfiram, the first medication to be FDA-approved for the treatment of AUD, has fallen out of favor due to its side effect profile and limited efficacy.[6] More recently, randomized controlled trials have found that acamprosate and naltrexone are each associated with meaningful reductions in alcohol use[7] with acamprosate being slightly more efficacious in promoting abstinence and naltrexone more so in reducing heavy drinking and cravings.[8] The American Psychiatric Association recommends that acamprosate or naltrexone be offered to patients with moderate to severe AUD who have a goal of reducing alcohol consumption, who prefer pharmacotherapy, or who have not responded

to nonpharmacological methods and do not have medical contraindications to their use.[9] Despite their potential to improve health outcomes and reduce healthcare costs, these medications continue to be underutilized with only 9% of people with AUD receiving any medication for treatment.[10]

Because people with AUD are less likely to seek primary care than those without AUD,[11] an inpatient stay can be a unique reachable moment to engage patients in AUD treatment while they are being treated for alcohol withdrawal and/or a health complication related to alcohol use.[12] Furthermore, some patients view hospitalization as a "wake-up call" regarding the risks of their SUD.[13] To meet the need for inpatient care of alcohol and other SUDs, inpatient addiction consultative services (ACSs) have been developed.[14] These interprofessional services consist of a multidisciplinary team and are dedicated to providing evidence-based SUD treatment, addressing complex medical decision making, patient engagement, and a focus on harm reduction. They also promote education and culture change among medical trainees and hospital staff.[15] Research examining the effect of these services has focused on patients with opioid use disorder[14,16–18] or SUD in general[19–23] and has found that these services are associated with decreased substance use after discharge,[20,22] increased engagement in outpatient care,[16,19] and mixed results regarding length of stay and readmissions.[21,24] To our knowledge, there is no research examining the association between an ACS and MAUD initiation when compared to a control population. Given that AUD is the most common SUD[25] and is responsible for substantial human, societal, and financial cost, interventions that increase access to evidence-based treatment are urgently needed.

To address the lack of research examining the impact of an ACS consultation on healthcare delivery to patients with AUD, we performed a propensity score–matched historical control analysis. We sought to determine the association between an ACS consultation and patient outcomes among patients admitted with an AUD diagnosis, including provision of MAUD during admission and MAUD at discharge. In addition, we sought to determine the association between an ACS consultation and patient-directed discharge, time to 7-day and 30-day readmission, and time to 7-day and 30-day post-discharge emergency room (ER) visit among patients diagnosed with AUD. We hypothesized that patients who received an ACS consult would be more likely to receive treatment with MAUD during their admission and at discharge.

METHODS

Setting and Patient Population

Weiler Hospital is one of three adult hospitals which make up Montefiore Medical Center. An academic hospital located in Bronx, New York, Weiler Hospital serves a primarily Hispanic/Latinx and non-Hispanic Black community in one of the nation's poorest urban counties.[26] Patients were eligible for inclusion in the study if they (1) were admitted prior to the launch of the ACS (hereafter, the "consult-unavailable" time period, April 27, 2019, through December 20, 2019) or during the "consult-available" time period (April 27, 2021, through December 20, 2021) and (2) had a primary or secondary diagnosis of AUD based on International Classification of Diseases (ICD-10) diagnosis. These time periods were chosen to include similar calendar days and to exclude times when COVID-19 was surging in the inpatient population due to the substantial change in patient population when this occurred. Because some admissions (24.7%) represent subsequent admissions for patients with multiple admissions, and each individual admission was a new opportunity for ACS consultation, we use *admission* rather than *patient* as the unit of analysis.

Intervention

The ACS launched at Weiler Hospital on April 20, 2021. The ACS is a hospital-based consult service that assists with substance use withdrawal management, SUD treatment, patient-centered harm reduction counseling, peer engagement, discharge planning, and linkage to outpatient care for patients with SUDs, including AUD. The service provides daily evaluation and recommendations for the care of patients during the admission. The interprofessional ACS consists of a multidisciplinary team including a board-certified addiction medicine attending physician, an addiction medicine fellow, a peer advocate, and other medical trainees. It works in close collaboration with social work and pharmacy.

Study Design

We evaluated the effect of an ACS consultation on patient care outcomes using electronic health record data. To address the potential for confounding by indication, wherein patients who received an ACS consult would have differing demographic, clinical, and hospitalization characteristics than those who did not, we used a propensity score–matched historical control design. Using this design, we created a control group with a similar likelihood of being consulted by the ACS if it were available. First, we identified the study-eligible population, consisting of two cohorts: (1) the consult-unavailable cohort consisted of admissions during the consult-unavailable time period, and (2) the consult-available cohort consisted of admissions during the consult-available time period. Then, to create the final matched study sample, each admission from the consult-available cohort who received an ACS consult was matched with a historical control admission from the consult-unavailable cohort using a propensity score matching protocol. This study was determined to be exempt by the Albert Einstein College of Medicine Institutional Review Board.

Measures

Outcomes. The two primary outcomes were new inpatient treatment with MAUD and new MAUD given at discharge. New inpatient treatment with MAUD was a dichotomous outcome defined as treatment with naltrexone (intra-muscular injection or oral tablet) or acamprosate during admission among patients who did not have an order or prescription for MAUD within 60 days prior to the admission. New MAUD given at discharge was a dichotomous outcome defined as a prescription for oral naltrexone or acamprosate at discharge or administration of intra-muscular naltrexone during admission, as this remains effective for 28 days, among patients who did not have an order or prescription for MAUD within 60 days prior to the admission. The distinction between new and continued MAUD treatment was important as there was a temporal trend for MAUD use prior to admission with a higher number of admissions with prior MAUD use later in the study period. Disulfiram was excluded due to lack of efficacy.[6] Secondary outcomes were patient-directed discharge, 7-day and 30-day readmission, and 7-day and 30-day post-discharge ER visit. Patient-directed discharge was a dichotomous outcome defined as a patient assigned a disposition code in the medical record for discharge against medical advice or elopement. Readmission and post-discharge ER visit outcomes were time-to-event variables defined as the number of days from discharge to first all-cause readmission or ER visit, censored at 7 or 30 days, within Montefiore Medical Center.

Covariates. To create propensity-matched cohorts, we examined the demographic, clinical, and hospitalization characteristics for each admission. Demographic characteristics included age, sex, race/ethnicity (Black/African American, Latinx, non-Hispanic white, and other/unknown), and insurance (commercial, Medicaid, Medicare, and other). Clinical characteristics included AUD diagnosis category (uncomplicated/intoxication, withdrawal, long-term complications, or remission), comorbid diagnosis for other SUD, diagnosis of liver disease, Charlson comorbidity index, and number of hospital admissions and ER visits at Montefiore Medical Center over the prior year. Clinical characteristics also included the maximum laboratory values of blood alcohol concentration, aspartate aminotransferase (AST) level, alanine transaminase (ALT) level, and creatinine level during the admission. ICD-10 codes for SUDs were used to define two dichotomous variables indicating the presence of opioid use disorder and other SUD (cocaine, stimulant, or sedative/hypnotic) (Appendix). Blood alcohol concentration was dichotomized to two values: undetectable and detectable. AST and ALT were categorized into three groups: $< 2\times$ upper limit of normal, 2–4× upper limit of normal, and $> 4\times$ upper limit of normal. Creatinine was categorized into three groups: $<$ 1.3 mg/dL, 1.3–2.0 mg/dL, and $>$ 2.0 mg/dL. Previous 1-year hospital admission and ER visits were categorized into four groups: none, 1–4 admissions/ER visits, 5–9 admissions/ER visits, and $\geq$ 10 admissions/ER visits. Hospitalization characteristics included medicine service at discharge (dichotomous) and admission to intensive care unit (ICU) from the ER (dichotomous).

Creation of Matched Cohorts

For each admission that received an ACS consult, we sought to a find a propensity score–matched control admission from the consult-unavailable time period. First, we created a propensity score model in the unmatched consult-available cohort to calculate the propensity to receive an ACS consult using a non-parsimonious model-building strategy, which included all demographic, clinical, and admission-level covariates. Next, the β-coefficients from the propensity score model were used to calculate propensity scores for all admissions in the unmatched consult-unavailable cohort. Finally, these cohorts were matched using a nearest neighbor protocol with a caliper width of 0.05 of the standard deviation of the logit of the propensity score. The matching protocol was repeated using different random sorts which yielded identical results. If balance was not achieved in all covariates after matching, we adjusted for the remaining differences between the study cohorts.

Analysis

First, the demographic, clinical, and hospitalization characteristics of the matched cohorts were compared using *t*-tests and chi square tests as appropriate. Next, to determine associations between an ACS consult and the dichotomous outcomes (new inpatient treatment with MAUD, new MAUD at discharge, and patient-directed discharge), we used univariable and multivariable logistic regression models. Then, to assess the association between an ACS consultation and the time to event outcomes (7-day and 30-day readmission and post-discharge ER visit, censored at 7 and 30 days), we used univariable and multivariable cox regression models. Adjustment variables were included in the multivariable models if bivariate testing yielded a p-value < 0.2. Because the unit of analysis was hospital admission, all regressions used cluster-robust standard errors to account for the clustering of multiple admissions within individual patients. Finally, to graphically depict the comparison of time-to-event outcomes between the matched cohorts, we used Kaplan-Meier failure function curves.

RESULTS

Study Population

There were 1416 admissions eligible for the study (1007 unique patients), including 777 admissions in the

consult-unavailable time period and 639 admissions in the consult-available time period. Of the admissions in the consult-available time period, 250 admissions received a consult by the ACS and the remaining 389 did not. Of the 250 admissions receiving a consult, 215 were successfully matched with a historical control admission yielding a final study sample of 430 admissions (324 unique patients) (Fig. 1).

When compared with matched historical controls, the admissions with an ACS consult were more likely to be Black/African American (37.7% vs 26.5%) and less likely to be Latinx (42.3% vs 49.8%). In addition, they were less likely to have detectable blood alcohol concentration (25.6% vs 32.6%), and more likely to have a maximum AST level 2–4× ULN (24.2% vs 16.7%) and more likely to have a maximum creatinine value greater than 2 mg/dL (9.3% vs 5.1%). Lastly, admissions with an ACS consult were more likely to be admitted to the ICU (8.8% vs 5.2%) (Table 1).

Inpatient Medication Treatment and Discharge Prescription

Admissions with an ACS consult were more likely to receive new inpatient treatment with MAUD in both the unadjusted model (33.0% vs 0.9%; OR 52.5 [CI 12.6–218.6]) and after adjustment for race/ethnicity, detectable blood alcohol concentration, maximum AST value category, maximum creatinine value category, and ICU admission (AOR 49.8 [CI 12.4–200.3]) when consulted by the ACS compared with historical controls. There was also a greater likelihood among admissions with an ACS consult to receive new MAUD at discharge in both unadjusted (41.4% vs 1.9%; OR 37.3 [CI 13.3–104.6]) and adjusted (AOR 36.3 [CI 12.6–104.8]) analyses when consulted by the ACS (Table 2).

Secondary Outcomes

Admissions with an ACS consult and matched historical controls had similar rates of patient-directed discharge in unadjusted (14.4% vs 15.8%; OR 0.9 [CI 0.5–1.6]) and adjusted (AOR 0.9 [CI 0.5–1.6]) analysis. Additionally, those admissions with an ACS consult and matched historical controls had similar rates of 30-day readmission (25.1% vs 23.7%; HR 1.1 [CI 0.7–1.7]; AHR 1.2 (0.7–1.8]) and 7-day readmission (6.5% vs 4.2%; HR 1.6 [CI 0.7–3.7]; AHR 1.8 (0.8–4.3]), and time to the first post-discharge ER visit at 30 days (33.5% vs 34.4%; HR 1.0 [CI 0.7–1.5]; AHR 1.0 (0.7–1.6]) and 7 days (13.0% vs 10.7%; HR 1.2 [CI 0.7–2.2]; AHR 1.5 (0.8–2.6]) (Table 2 and Fig. 2).

DISCUSSION

In a carefully controlled propensity score–matched evaluation of an inpatient ACS, we found that consultation by the ACS is associated with a marked increase in initiation of new MAUD during admission and a similarly

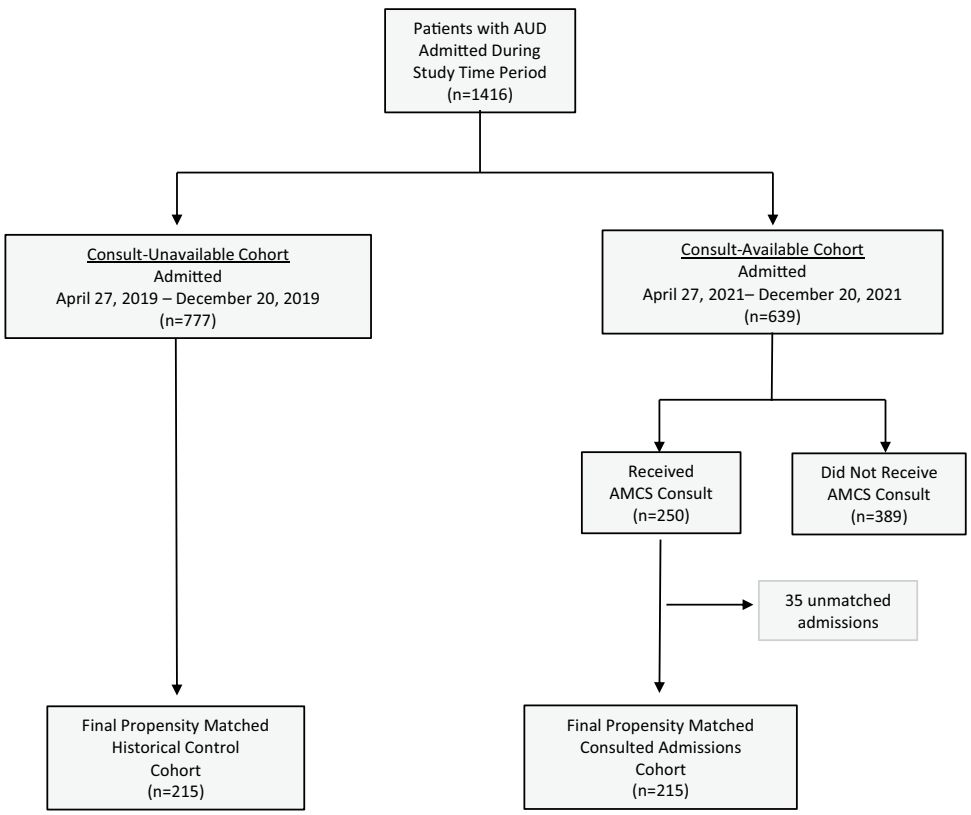

Figure 1 Participant flow diagram.

Table 1 Baseline Characteristics of Propensity Score–Matched Populations

Characteristic	Historical controls ($n = 215$)	Consulted admissions ($n = 215$)	p-value
Age, mean (SD)	52.1 (11.9)	52.5 (11.9)	0.77
Male sex, %	158 (73.5%)	149 (69.3%)	0.34
Race/Ethnicity, %			0.02
Black/African American	57 (26.5%)	81 (37.7%)	
White (non-Hispanic)	34 (15.8%)	20 (9.3%)	
Hispanic/Spanish/Latinx	107 (49.8%)	91 (42.3%)	
Other race/unavailable*	17 (7.9%)	23 (10.7%)	
Insurance type, %			0.98
Private	15 (7.0%)	17 (7.9%)	
Medicaid	144 (67.0%)	144 (67.0%)	
Medicare	55 (25.6%)	53 (24.7%)	
Other	1 (0.5%)	1 (0.5%)	
ICD-10 diagnosis, %†			0.60
Alcohol dependence, uncomplicated (inc. intoxication)	65 (30.2%)	64 (29.8%)	
Alcohol dependence w/ withdrawal	136 (63.3%)	135 (62.8%)	
Alcohol dependence w/ long-term complications	13 (6.1%)	12 (5.6%)	
Alcohol dependence in remission	1 (0.5%)	4 (1.9%)	
Opioid use disorder, %†	30 (14.0%)	28 (13.0%)	0.78
Other substance use disorder, % ‡†	32 (14.9%)	40 (18.6%)	0.30
Liver disease, % †	112 (52.1%)	108 (50.2%)	0.70
Charlson Comorbidity Index ≥ 2	122 (56.7%)	120 (55.8%)	0.85
Elevated blood alcohol concentration, %§	70 (32.6%)	55 (25.6%)	0.11
Aspartate aminotransferase level, % §			0.13
0–66 U/L (≤ 2× ULN, ≤ 4× ULN)	128 (59.5%)	122 (56.7%)	
67–132 U/L (> 2× ULN, ≤ 4× ULN)	36 (16.7%)	52 (24.2%)	
> 132 U/L (> 4× ULN)	51 (23.7%)	41 (19.1%)	
Alanine transaminase level, % §			0.62
0–72 U/L (≤ 2× ULN)	174 (80.9%)	166 (77.2%)	
73–144 U/L (> 2× ULN, ≤ 4× ULN)	24 (11.2%)	30 (14.0%)	
> 144 U/L (> 4× ULN)	17 (7.9%)	19 (8.8%)	
Creatinine, % §			0.18
< 1.3 mg/dL	186 (86.5%)	173 (80.5%)	
1.3–2.0 mg/dL	18 (8.4%)	22 (10.2%)	
> 2 mg/dL	11 (5.1%)	20 (9.3%)	
Previous admissions in the last year, %			0.29
None	101 (47.0%)	84 (39.1%)	
1–4 admissions	77 (35.8%)	94 (43.7%)	
5–9 admissions	25 (11.6%)	22 (10.2%)	
≥ 10 admissions	12 (5.6%)	15 (7.0%)	
Previous ER visits in the last year, %			0.79
None	50 (23.3%)	44 (20.5%)	
1–4 visits	94 (43.7%)	104 (48.4%)	
5–9 visits	37 (17.2%)	34 (15.8%)	
≥ 10 visits	34 (15.8%)	33 (15.4%)	
Discharged from medicine service, %	196 (91.2%)	200 (93.0%)	0.48
Admitted to ICU, %	11 (5.2%)	19 (8.8%)	0.13

*Includes Asian, Native American/Alaskan Native, and race not available

†Based on ICD-10 diagnosis code listed at discharge

‡Other substance use disorders include use of cocaine, sedative/hypnotics, and stimulants based in ICD-10 diagnosis

§Maximum value during hospitalization

large increase in new MAUD at discharge among admitted patients with AUD. ACS consultation was not associated with a significant change in patient-directed discharge, time to readmission, or time to post-discharge ER visit.

Our study, among the first to examine AUD outcomes of ACS consultation, found a large increase in inpatient treatment with MAUD and discharge MAUD associated with an ACS consultation. This finding suggests that there may be a large unmet need in hospitals where an ACS is not currently available. It is also consistent with previous research indicating marked underutilization of MAUD among people with AUD.[10] Untreated AUD has far-reaching consequences. Thus, an intervention that leads to such a large increase in evidence-based use of MAUD has potential for significant individual and societal benefits and makes a compelling case for the initiation of an ACS

Table 2 Outcomes

	Historical controls ($n = 215$)	Consulted admissions ($n = 215$)	*p*-value	Odds ratio (CI) unadjusted	Odds ratio (CI) adjusted*
New inpatient treatment	2 (0.9%)	71 (33.0%)	<0.001	52.5 (12.6–218.6)	49.8 (12.4–200.3)
New MAUD at discharge	4 (1.9%)	89 (41.4%)	<0.001	37.3 (13.3–104.6)	36.3 (12.6–104.8)
Patient-directed discharge	34 (15.8%)	31 (14.4%)	0.67	0.9 (0.5–1.6)	0.9 (0.5–1.6)
	Historical controls ($n = 215$)	**Consulted admissions ($n = 215$)**	***p*-value**	**Hazard ratio (CI) unadjusted**	**Hazard ratio (CI) adjusted***
30-day readmission	51 (23.7%)	54 (25.1%)	0.74	1.1 (0.7–1.7)	1.2 (0.7–1.8)
7-day readmission	9 (4.2%)	14 (6.5%)	0.28	1.6 (0.7–3.7)	1.8 (0.8–4.3)
30-day ER visit	74 (34.4%)	72 (33.5%)	0.84	1.0 (0.7–1.5)	1.0 (0.7–1.6)
7-day ER visit	23 (10.7%)	28 (13.0%)	0.46	1.2 (0.7–2.2)	1.5 (0.8–2.6)

*Adjusted for race/ethnicity, blood alcohol concentration, maximum AST value, maximum creatinine value, and ICU admission

in any hospital setting where AUD is prevalent. An important strength of this study is the large proportion of Black/African American and Latinx patients, representative of communities in Bronx, New York. Given existing racial and ethnic disparities in receipt of evidence-based treatment of AUD, our study suggests that ACS might provide opportunities to mitigate them.[27]

We found that an ACS consultation was not associated with a reduction in patient-directed discharge. Of note, there was a high rate of patient-directed discharge in the study sample (14%) compared to the general inpatient population rate of 1.4%[28], which is consistent with prior research examining patients with SUDs.[29,30] A previous study of factors influencing patient-directed discharges among patients

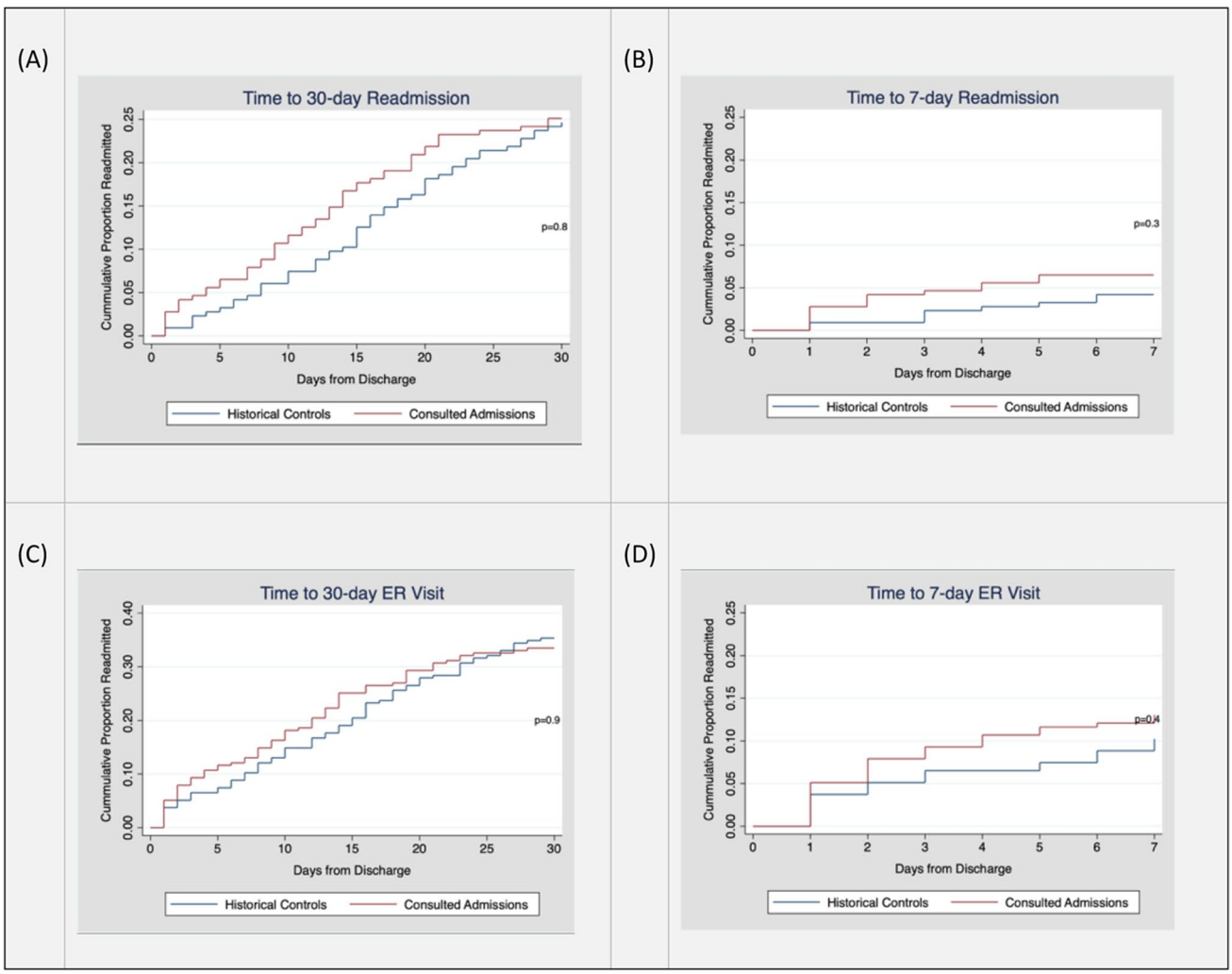

Figure 2 A–D Seven-day and 30-day readmission and 7-day and 30-day post-discharge ER visit for admissions receiving ACS consultation vs propensity-matched historical controls.

with SUD found that undertreatment of withdrawal, ongoing craving to use substance(s), acute or chronic pain, perception of stigma or discrimination by hospital staff, hospital rules restricting movement out of a room, and psycho-social factors were among the most common reported reasons.[31] While an ACS consultation might be expected to address some of these factors, it seems unlikely that this intervention alone can influence all factors associated with patient-directed discharges.

We further found that an ACS consultation was not associated with reductions in readmissions or post-discharge ER visits. Previous research examining ACS outcomes has studied patients with SUD in general[19,21,22,24]or with opioid use disorder specifically.[14,16,18] These studies found mixed results regarding readmission[21,24] among hospitalized patients who received ACS consultation. However, studies have consistently shown that patients with SUD are more likely to have readmissions and ER visits, compared with admitted patients without SUDs.[32–34] Within our study population, 30% of admissions had at least 5 ER visits over the previous year and 17% had at least 5 hospital admissions over the previous year, suggesting the population was at high risk for subsequent utilization. A study examining inpatient MAUD initiation and 30-day readmission and post-discharge ER visit found that patients provided with MAUD had reduced rates of readmission and ER visits when compared to those who did not.[35] This study was limited by unadjusted analysis which did not account for potential differences between those who did and did not receive MAUD. This may help explain why we did not find the same benefit. Another impactful characteristic of our study population is the degree of comorbidity. 56% of our sample had a Charlson comorbidity index of two or greater, indicating that the study population had significant medical comorbidities which might contribute to the risk of readmission. This high level of medical comorbidity suggests that additional resources beyond these medications are likely necessary to meaningfully address the health complexity of patients with AUD. In addition, the high health care utilization, even among those with ACS consultation and receipt of MAUD, highlights that AUD is a chronic condition that often requires many points of contact over time.

Our study has several limitations. Firstly, it was a single center observational study, and the findings may not be generalizable to all settings. Secondly, because this is an observational study, the possibility of confounding remains. We addressed this issue by using a propensity score–matched historical control design; however, there is potential for residual confounding due to uncollected or unmeasured variables. Finally, we examined proximal health care delivery outcomes related to a patient's hospitalization. Future studies will be needed to examine linkage to outpatient care, long-term medication treatment adherence/continuation, alcohol use outcomes, and mortality.

Overall, this study extends previous research on the benefits of ACS consultation to include benefits in increasing medication treatment access among hospitalized patients with AUD. However, we did not find a reduction in readmission or post-discharge ER visits as had been previously reported. This is a population with high medical acuity, comorbidity, and significant barriers to health access. The degree to which an ACS can meaningfully increase patients' access to effective and evidence-based medication treatment for AUD provides a convincing case for implementing an ACS to increase provision of medication for this substantially undertreated disease.

CONTRIBUTORS

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Data Availability *Supporting information is available from the authors on request.*

Declarations

Conflict of Interest *The authors declare that they do not have a conflict of interest.*

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