Original Research

Hospital Readmission in Alcohol Use Disorder Patients: The Role of Anti-Craving Medications and Discharge Disposition

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Abstract

Background
Alcohol use disorder (AUD) results in frequent hospital readmissions. Although the literature has shown the efficacy of anti-craving medications (ACM), they are infrequently prescribed upon discharge. The outcomes of discharge to substance use treatment facilities (STF) have also not been fully explored. This study seeks to determine the impact of ACM as well as discharge to STF on readmissions for people with AUD.

Methods
This retrospective case-control study analyzed encounters made within HCA Healthcare hospitals across the United States from 2016 to 2018 for adults with AUD. The case definition was the presence of ACM defined as acamprosate or naltrexone upon discharge as well as discharge disposition (STF vs. all others). The main outcomes were the likelihood of 30- and 90-day readmission and blood alcohol concentration (BAC) on 30-day readmission in cases versus adults with AUD declining/not referred to an STF or not using ACM. The controlled variables included age, sex, race, and insurance status.

Results
A total of 14 691 patients were identified for the study. Of these, 3308 patients were prescribed ACM and 1125 patients were discharged to an STF. Patients without ACM were 1.18 times more likely to be readmitted within 30 days (95% CI, 1.07-1.30; P = .0005). Patients discharged to an STF were 1.57 times more likely to be readmitted within 30 days (95% CI, 1.37-1.79; P < .0001), but these patients had a BAC that was 26.74 units lower on 30-day readmission than those who were not discharged to an STF.

Conclusion
The prescription of ACM on discharge was associated with decreased 30-day readmission rates. The lower BAC of those who were readmitted within 30 days suggests discharge to STF may be beneficial for the treatment of AUD in the longer term. Practitioners are encouraged to prescribe ACM for people admitted with AUD to reduce the likelihood of 30-day readmission.

Keywords
alcohol use disorder; readmission; discharge disposition; acamprosate; naltrexone; anti-craving medication

Introduction
Alcohol use disorder (AUD) often results in hospital readmissions.[1] The inpatient setting provides an opportunity for treating AUD and initiating anti-craving medication (ACM) upon discharge. Naltrexone and acamprosate are medications that are FDA-approved and shown to be effective in preventing alcohol use relapse.[2] A double-blind randomized control trial with over 6000 subjects showed a decrease

in the immediate recurrence of alcohol use relapse in those assigned to acamprosate compared to a placebo.[3] Decreased adherence to ACM is also associated with an earlier relapse in alcohol consumption.[4] Yet less than 9% of patients with AUD are prescribed medications.[5]

ACMs for AUD have been shown to decrease patients' lengths of stay in hospitals and to reduce healthcare costs.[6] Initiation of a discharge-planning protocol, which included treatment with naltrexone, was associated with a decrease in 30-day hospital readmission rates and emergency department visits.[1] In another study, treatment for hospitalized trauma patients with AUD increased cost savings for hospitals, insurers, and government agencies.[7] These cost savings were reflective of a reduction in injuries requiring emergency room treatment or hospitalization. Despite evidence in the literature, only 7% of substance use disorder (SUD) treatment programs offered acamprosate during its first year of availability in the United States.[8] A prospective study showed that patients who received pharmacotherapy for AUD following discharge from residential AUD programs had a delay in alcohol use, fewer relapses, and decreased need for inpatient treatment.[9]

A retrospective cohort study reported that AUD-related admissions were associated with a mortality rate of 11% and accrued over 7 million dollars in cost over a 6-month period.[10] The majority of admitted patients were discharged home without continuity of care for their AUD.[10] However, transitioning patients to a residential or outpatient SUD treatment program after discharge has been shown to significantly reduce readmission rates and associated costs.[11] Anti-craving medications affect patients' alcohol use relapse, but there is a lack of data on whether ACM have a positive effect on hospital readmissions. The present retrospective cohort study serves to determine whether there is an association between the ACM prescribed as well as disposition on discharge to reduce 30- and 90-day hospital readmission rates as well as decreased blood alcohol concentration (BAC) upon 30-day readmission.

Methods

Study Design and Sample

This retrospective study reviewed all existing encounters made within HCA Healthcare facilities across the United States from January 2016 to December 2018. HCA Healthcare is comprised of 185 hospitals and 2000 sites of care, including surgery centers, urgent care centers, emergency rooms, and physician clinics in 21 states across the United States. All collected data and patient information were de-identified prior to analysis. Institutional review board exemption was obtained after review by the HCA Healthcare Institutional Review Board manager system. Data collection was conducted from January 2019 to February 2020.

We queried the HCA Healthcare electronic admission, discharge, inpatient medication, and billing records during the data collection period for all patients aged 18 to 65 years. Patients included in the cohort required a diagnosis of AUD (ICD 10 code F10 or ICD 9 code 303.90-303.92). Data were limited to hospitalized patients. The corresponding medical records were then used to extract demographic information, discharge disposition, length of stay, and the discharge medication list.

Measures

The independent variable was the presence of the ACM on the discharge medication list following hospitalization. The ACMs were characterized as acamprosate or naltrexone appearing on the discharge medication list at any dosage. Discharge disposition, defined as whether the patient was discharged home or referred to a substance use treatment facility (STF), was also reviewed as an intervention. Age, gender, race, and insurance status were measured as covariates. The primary outcome was whether or not the patient was readmitted within 30 and 90 days of discharge. The secondary outcome was the blood alcohol concentration measured on 30-day readmissions.

Statistical Analysis

Multivariate logistic regression was performed to evaluate the association of ACM and the likelihood of 30- and 90-day readmissions, as both of the outcomes are binary. The odds ratio (OR) was calculated from the logistic regression model. Linear regression was performed to model the association of the presence of ACM on discharge and BAC upon 30-day readmission. Controlled variables for all

Table 1. Patient Characteristics

	Total (N=14 691)		Received ACM (n=3308)		Did not receive ACM (n=11 383)	
	n	%	n	%	n	%
Sex						
Male	9953	67.7	2165	65.4	7788	68.4
Female	4738	32.3	1143	34.6	3595	31.6
Race/ethnicity						
White	11 195	76.2	2817	85.2	8378	73.6
Other	3496	23.8	491	14.8	3005	26.4
Insurance type						
Uninsured	5407	36.8	1020	30.8	4387	38.5
Insured	9284	63.2	2288	69.2	6996	61.5

regression models include age, sex (male versus female), race (white versus non-white), and insurance status (insured versus uninsured). A generalized linear models procedure was used to calculate the association of the aforementioned variables with BAC on 30-day readmission. All data were analyzed by SAS 9.4.

Results

Baseline characteristics including demographics are shown in **Table 1**. A total of 14 691 patients aged 18 to 65 years were admitted to an HCA Healthcare hospital with the diagnosis of AUD from January 2016 to December 2018. The average age of patients sampled was 45.8 years. A total of 9953 (67.75%) patients were male and 11 195 (76.2%) patients identified as white. There were 5407 (36.8%) uninsured patients. **Table 2** shows discharge outcomes of patients admitted with AUD. 3308 (22.52%) patients were prescribed an ACM and 1125 (7.66%) patients were discharged to a STF. There were 3448 (23.47%) patients readmitted within 30 days while 5198 patients (35.38%) were readmitted within 90 days.

Tables 3 and 4 show the results of multivariate logistic regression models for 30-day and 90-day readmissions. Patients discharged to a STF were more likely to be readmitted within 30 days (OR = 1.57, 95% CI, 1.37-1.79; $P < .0001$). For every 1-year increase in age, patients were more likely to be readmitted within 30 days (OR = 1.013, 95% CI, 1.01-1.02; $P < .0001$). Non-white patients were less likely to be readmitted within 30 days (OR = 0.85, 95% CI, 0.76-0.92; $P = .0002$). Patients with insurance were more likely to be readmitted within 30 days (OR = 1.168,

Table 2. Discharge Outcomes

	Total (N=14 691)		Received ACM (n=3308)		Did not receive ACM (n=11 383)	
	n	%	n	%	n	%
Readmitted within 30 days						
Yes	3448	23.5	709	21.4	2739	24.1
No	11 243	76.5	2599	78.6	8644	75.9
Readmitted within 90 days						
Yes	5198	35.4	1173	35.5	4025	35.4
No	9493	64.6	2135	64.5	7358	64.6
Discharged to STF						
Yes	1125	7.7	275	8.3	850	7.5
No	13 566	92.3	3033	91.7	10 533	92.5

Table 3. Predictors of 30-day Readmissions

Variable	Odds ratio	95% confidence intervals	*P* value
Female	0.785	0.720-0.855	< .0001
Discharged to rehab	1.569	1.376-1.795	< .0001
Insured	1.168	1.074-1.271	.0003
Non-white	0.835	0.760-0.918	.0002
No anti-craving home medication	1.186	1.078-1.305	.0005
Age in years	1.013	1.010-1.016	< .0001

95% CI, 1.07-1.21; *P* = 0.0003). Females were less likely to be admitted with 30 days (OR = 0.78, 95% CI, 0.72-0.85; *P* <0.0001).(**Figure 1A**)

ACMs did not have a significant relationship with 90-day readmission rates. Patients discharged to STF were more likely to be readmitted within 90 days (OR = 1.29, 95% CI, 1.14-1.46; *P* < .0001). For every increase of 1 year in age, patients were more likely to be readmitted within 90 days (OR = 1.014, 95% CI, 1.011-1.016; *P* < .0001). Non-white patients were less likely to be readmitted within 90 days (OR = 0.865, 95% CI, 0.796-0.939; *P* = .0005). Patients with insurance were more likely to be readmitted within 90 days (OR = 1.204, 95% CI, 1.117-1.296; *P* < 00001). Females were less likely to be admitted within 90 days with an OR = 0.855 (95% CI, 0.793-0.921; *P* < .0001). (**Figure 1B**)

ACM, age, and race did not have a significant relationship with BAC on 30-day readmission. While patients who were discharged home had a lower likelihood of 30-day readmission, those that were readmitted had a BAC 26.74 units higher than that of readmitted patients who were discharged to an STF (*P* = .041). Female patients also had a BAC 22.89 units lower than male patients at readmission (*P* = .0002). Although patients that were insured were more likely to be readmitted, they had a BAC 34.13 units lower than uninsured patients at readmission (*P* < .0001). For every 1-day increase in the length of stay, the BAC of readmitted patients decreased by 5.11 units (*P* < .0001).

Discussion

A previous study showed that patients who received ACM had decreased need for future inpatient treatment.[9] Patients who received ACM in our study were less likely to be readmitted within 30 days than those who did not. However, only 22.52% of the patients with AUD received ACM. Our findings are consistent with previous studies that show limited usage of naltrexone and acamprosate in potential treatment settings.[5,8] Regional differences in policies, as well as lack of familiarity with ACM by general practitioners, may contribute to the limited use of ACM. There is a statistically significant association between the usage of naltrexone or acamprosate and the reduction of 30-day readmissions. While the association may not be clinically significant, future studies should focus on proper dosages as well as

Table 4. Predictors of 90-day Readmissions

Variable	Odds ratio	95% confidence intervals	*P* value
Female	0.855	0.793-0.921	< .0001
Discharged to rehab	1.288	1.138-1.462	< .0001
Insured	1.204	1.117-1.296	< .0001
Non-white	0.865	0.796-0.939	.0005
No anti-craving home medication	1.017	0.936-1.105	.6902
Age in years	1.014	1.011-1.016	< .0001

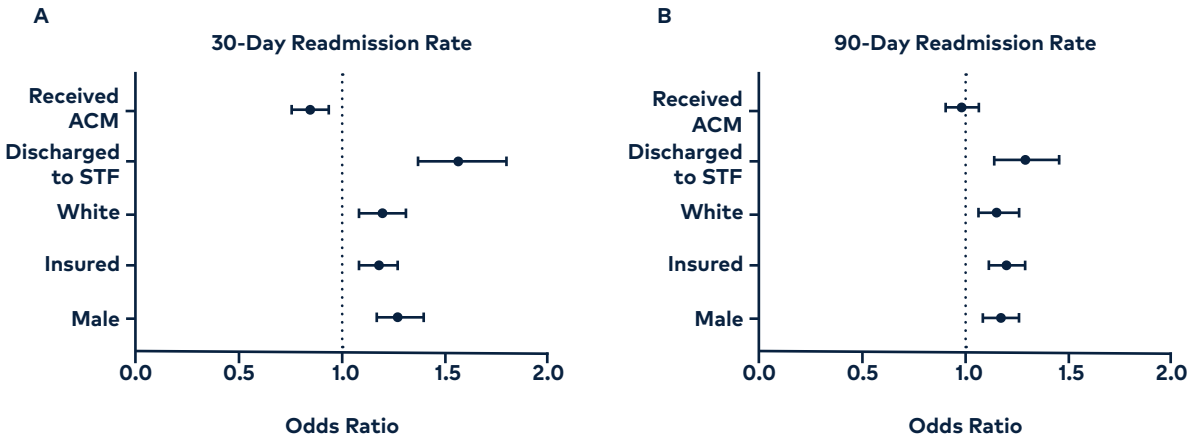

Figure 1. Predictors for (A) 30- and (B) 90-day readmission rates.

long-term benefits of ACM to prevent alcohol use relapse and further explore any potential connection.

Sex, race, and insurance were all significant predictors of readmission rates in patients receiving ACM. A 1-year increase in age lacks clinical significance since the odds ratio for 30-day readmissions was close to 1. Future studies should explore how age impact readmissions for AUD. The elderly population is more likely to have co-existing medical conditions, which may be worsened by alcohol use. Elderly patients generally use more medications, which may cause adverse reactions when mixed with alcohol.[12] Females with AUD were less likely to be readmitted in 30 days compared to males. This could be due to a number of factors such as increased adherence to AUD treatment in females, or males' greater dependency on alcohol to relieve negative affective states. Males have been shown to have higher rates of AUD than females and generally consume alcohol in greater quantities.[13] We also found that non-whites had lower readmission rates compared to whites. Further exploration, including qualitative studies, needs to examine how sex and race, as well as other social factors, may play a role in AUD treatment outcomes.

Our study used the presence of insurance as a marker to approximate financial status. Insured patients were more likely to be readmitted within 30 days. Insured patients were also associated with a lower BAC, suggesting this population may have greater motivation to be readmitted once they relapse. This is attributed to available resources and health support systems, although prospective clarifying research is needed. Basu et al. have shown that in the uninsured population there was a lower risk of readmission in minority populations and an increased risk among the white population, compared to both racial groups with private insurance.[14] This is similar to our findings. However, Basu et al. suggested that decreased readmission rates are not necessarily a positive outcome as that may be due to lack of access to medical care or financial barriers.[14]

Only a small portion (7.66%) of patients in the study were discharged to an STF. Patients discharged to a treatment facility were more likely to be readmitted. It is likely due to the facility's ability to observe patients for criteria requiring readmission as well as the patients' own motivation to seek help for their AUD. This outcome was further supported by findings that showed patients discharged to STFs had lower BAC upon 30-day readmission. STFs have the ability to encourage adherence to ACM and also offer therapy for alcohol use cessation. This finding is supported by a previous study that demonstrated long-term abstinence after inpatient rehabilitation.[15] A higher BAC on readmission for those not discharged to an STF suggests that these patients came from an environment that was unsupportive of their sobriety. Our research indicated that ACM did not demonstrate a relationship with BAC on readmission. However, the combination of ACM and discharge to STFs needs to be further explored as

they may have a synergistic effect in reducing the overall length of hospitalization in those with AUD.

There are several limitations of this study. First is the lack of data on patient compliance with ACM upon discharge. Despite this limitation, the effects from short-term utilization of ACM may persist beyond the treatment period. Patients have shown positive results even after discontinuing treatment with ACM.[16] Second, the study does not include disulfiram, which is still used in some settings for some patients. Third, the study does not specify whether rates vary based on admission to a psychiatric bed versus a general medical bed. The variables presented may differ between the admission units. Fourth, the study is not able to identify why the use of ACM is relatively low, and referral to STFs is lower yet. Prospective and qualitative data would help to answer these questions and further inform providers involved in the care of patients with AUD. Our data were limited specifically to HCA Healthcare hospitals. Studying patients in non-HCA Healthcare hospitals may reveal different results due to factors such as the decision to treat with ACM and the threshold for admission. Data on BAC was limited to the difference in levels for each demographic. Measuring average BAC levels would help better understand the impact of ACMs.

Conclusion

Our study indicates that patients who have AUD and were discharged with ACM had decreased likelihood of being readmitted within 30 days. Although those discharged to STFs were more likely to be readmitted within 30 days, they had lower BAC on readmission. Education of best practices with providers may increase the use of ACM and STFs. Future studies should examine the long-term benefits of ACM as well as the transfer of care to STFs for the treatment of AUD.

Author Contributions

JC contributed to the conception and design as well as the initial writing of this manuscript. JB and MH contributed to data analysis and initial writing and editing. SN provided supervision of the project as well as revision of the manuscript. YJ was involved in the design, interpretation and visualization of results, and the initial draft of the manuscript.

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Conflicts of Interest

The authors declare they have no conflicts of interest.

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