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The Association between Medical Comorbidity and HEDIS Measures of Treatment Initiation and Engagement for Alcohol and Other Drug Use Disorders

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Abstract

Background: Medical comorbidity may influence treatment initiation and engagement for alcohol and other drug (AOD) use disorders. We examined the association between medical comorbidity and Healthcare Effectiveness Data and Information Set (HEDIS) treatment initiation and engagement measures.

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Methods: We used electronic health record and insurance claims data from seven US health care systems to identify patients with AOD use disorders between October 1, 2014 and August 15, 2015 (N = 86,565). Among patients identified with AOD use disorders in outpatient and emergency department (ED) settings, we examined how Charlson/Deyo comorbidity index scores and medical complications of AOD use were associated with treatment initiation. Among those who initiated treatment in inpatient and outpatient/ED settings, we also examined how comorbidity and AOD use-related medical complications were associated with treatment engagement. Analyses were conducted using generalized estimating equation logistic regression modeling.

Results: Among patients identified as having an AOD diagnosis in outpatient and ED settings (n = 69,965), Charlson/Deyo comorbidity index scores of two or more were independently associated with reduced likelihood of initiation (RR = 0.80; 95% CI = 0.74, 0.86; reference score = 0) whereas prior year diagnoses of cirrhosis (RR = 1.25, 95% CI = 1.12, 1.35) and pancreatic disease (RR = 1.34, 95% CI = 1.15, 1.56) were associated with greater likelihood of initiation. Among those who were identified in outpatient/ED settings and initiated, higher comorbidity scores were associated with lower likelihood of engagement (score 1: RR = 0.85, 95% CI = 0.76–0.94; score 2+: RR = 0.61, 95% CI = 0.53, 0.71).

Conclusions: Medical comorbidity was associated with lower likelihood of initiating or engaging in AOD treatment, but cirrhosis and pancreatic disease were associated with greater likelihood of initiation. Interventions to improve AOD treatment initiation and engagement for patients with comorbidities are needed, such as integrating medical and AOD treatment.

INTRODUCTION

Healthcare Effectiveness Data and Information Set (HEDIS®) measures are influential performance measures for health insurance plans and delivery systems because they are used to generate health plan rankings and may be linked to financial incentives. As a result, such measures can help promote and guide quality improvement initiatives. For alcohol and other drug (AOD) use disorders, HEDIS measures were developed by the Washington Circle and implemented by the National Committee for Quality Assurance (NCQA)[1] and the Department of Veterans Affairs.[2] These measures are used to measure initiation and engagement rates in treatment for AOD use disorders.

In community and specialty treatment settings, several factors have been associated with AOD treatment initiation, including sociodemographic factors (e.g., age,[3] race,[4–6] sex,[3,7] employment[7]), addiction severity,[7] recent arrest,[8] and psychiatric comorbidity.[3,8] Additionally, the setting of care in which the individual is identified with an AOD use disorder (e.g., inpatient medical, inpatient AOD specialty, and outpatient AOD specialty treatment) has been strongly associated with treatment initiation and engagement.[9] In particular, engagement has been shown to be higher for individuals identified in specialty AOD treatment settings compared with general medical settings.[9] Patients with AOD use disorders who are identified upon entering AOD treatment may differ from those who are identified in medical settings in a myriad of ways that impact treatment initiation and engagement rates, including their readiness and ability to access treatment and the severity

of their medical conditions. Yet little is currently known about how medical comorbidity impacts AOD treatment initiation and engagement.

Medical problems may be associated with AOD initiation and engagement for several reasons. First, medical problems that result from or are exacerbated by substance use, such as HIV, hepatitis C, pancreatitis, or overdose, are often markers of AOD use disorder severity.[10] As such, they may be associated with improved AOD treatment initiation and engagement because they could motivate physicians to identify AOD use disorders, refer patients to AOD treatment, and facilitate engagement.[11] These medical conditions may also motivate patients to enter or remain in treatment, and encourage family members to support patient initiation and engagement. Some providers require patients to complete AOD treatment as a precondition of receiving treatment for co-occurring health conditions, such as hepatitis C or liver transplants.[12] Even for medical comorbidities that are largely independent of substance use (e.g., chronic renal insufficiency, diabetes), frequent contact with the healthcare system could increase opportunities for screening, diagnosis, and referral to AOD treatment.

On the other hand, medical comorbidities may also negatively influence individuals' ability to initiate and engage in AOD treatment.[13] Medical comorbidities may have cognitive effects, physical symptoms, and associated disabilities that make it difficult for patients to attend the required number of visits within the time windows specified by the HEDIS measures. Further, they may lead to competing demands and higher health care costs that limit participation in AOD treatment. For example, conditions such as congestive heart failure may lead to a high baseline burden of medical visits, medical costs, and symptoms, such as dyspnea on exertion. Further, if medical complications of AOD use act as a marker of AOD use disorder severity, then attendance in the requisite visits to meet engagement criteria (two within 30 days of initiation or inpatient discharge) may be more challenging due to the AOD use disorder itself.

Given these competing hypotheses, we sought to determine the independent associations between a global measure of medical comorbidity and specific medical complications of substance use with HEDIS-defined AOD treatment initiation and engagement. Gaining a better understanding of the impact of medical comorbidity on the HEDIS initiation and engagement measures can inform interventions to improve access and delivery of AOD treatment services to medically complex patients in large health systems. Further, initiation and engagement rates provide benchmarks to determine progress on achieving recommended practices.

METHODS

Study Design, Settings, and Population

This multi-site retrospective cohort study was based on data from seven US health care delivery systems that are members of the Health Systems Node of the NIDA Clinical Trials Network. We examined AOD treatment initiation and engagement between October 1, 2014 and August 15, 2015 among adult patients (age ≥ 18) who qualified for the HEDIS measure denominator[14,15] and were continuously enrolled in one of the health systems 60 days prior

to through 44 days after the index date. This research was reviewed and approved by the Kaiser Permanente Northern California Institutional Review Board. This study met requirements for a waiver of informed consent.

Data Sources

Data were extracted from each site's Virtual Data Warehouse (VDW), a standardized data model that was developed for research use across the Health Care Systems Research Network (HCSRN).[16,17] The VDW represents a common data structure for electronic health record (EHR), insurance claims, and other administrative data for research purposes that have been extracted and loaded into relational tables linked through a common, unique identifier.[18–20] VDW diagnosis and procedure files include coded diagnoses and procedures associated with inpatient and outpatient encounters. These codes are based on International Classification of Diseases, 9th edition, Clinical Modification (ICD-9 CM), Healthcare Common Procedure Coding System (HCPCS), and the Fourth Edition of the Common Procedure Terminology codes (CPT-4).

Outcomes – Initiation and Engagement

Data elements required for calculating the HEDIS performance measures were extracted from the VDW databases and included: Diagnosis-related group categories, ICD-9 CM diagnosis codes, CPT codes, Uniform/Universal Billing Form 92 Revenue codes, Centers for Medicare & Medicaid Services (CMS) 1500 site of service codes, department, and date of services. Following the NCQA Measure Technical Specifications, AOD initiation and engagement rates were calculated only for adult patients who had a "new" index episode (defined by having a period of at least 60 days before the episode without a diagnosis of AOD abuse or dependence) with an AOD abuse or dependence diagnosis between October 1, 2014 and August 15, 2015.[14] An index identification setting could be an outpatient, observation/emergency department (ED), or inpatient claim/encounter/discharge, including AOD specialty treatment. If more than one diagnosis qualified an individual for inclusion, the first (primary diagnosis) classified the index as alcohol vs. drug abuse/dependence. If the index episode was any inpatient discharge, consistent with the HEDIS definition of initiation, the inpatient stay was considered to have met treatment initiation, regardless of whether the admission was to an inpatient AOD treatment program or a medical hospitalization. If the index episode was an ED or outpatient claim/encounter, the patient had to have a subsequent AOD service (not including an ED visit or detoxification inpatient stay) within 14 days of the index episode to be considered "initiated". For the engagement measure, patients who had two or more AOD-related services within 30 days after initiating treatment (or hospital discharge) were considered "engaged".

Study Variables

We examined patient characteristics, including age, sex, and race/ethnicity. We extracted all ICD-9-CM AOD abuse/dependence diagnoses in the year prior to the index identification visit, including alcohol, opioid, barbiturate, cocaine, cannabis, amphetamine, hallucinogen, and unspecified. Based on diagnosis codes in the year prior to the index date, the Deyo version of the Charlson comorbidity index was calculated for all patients.[21,22] The Charlson/Deyo index was designed to account for comorbidity and disease severity using ICD-9 and

procedure codes, with increasing score associated with worse outcomes, including one-year mortality. Conditions were given weighted scores, ranging from one to six. For our study, we categorized scores as 0, 1, and 2 or more, based on the distribution of scores in our sample. For medical complications of AOD use or other AOD-related conditions, we extracted medical and psychiatric diagnoses in the year prior to the index identification date based on the Healthcare Cost and Utilization Project (HCUP) classification system.[23] We also extracted 21 Substance Abuse-Related Medical Conditions (SAMC) based on the ICD-9-CM diagnosis codes.[24] From the HCUP and SAMC categories, we examined AOD diagnostic groups based on clinical relevance for our research questions. While not a medical complication of AOD use per se, we included pregnancy and childbirth due to the potential for poor outcomes associated with untreated AOD use disorders.

Statistical Analysis

Our analyses examined the association between medical comorbidity and the following: (1) *treatment initiation* among patients identified with an AOD use disorder in outpatient and ED settings; (2) *treatment engagement* among patients who were identified with an AOD use disorder in any inpatient setting (includes AOD disorder and medical treatment settings) and initiated treatment; and (3) *treatment engagement* among patients who were identified with an AOD use disorder in outpatient and ED settings (includes outpatient AOD use disorder treatment settings) and initiated treatment. There are strong associations between setting and initiation/engagement rates[9] and HEDIS criteria for initiation are met if the index encounter was for inpatient treatment. Therefore, we could not examine factors associated with treatment initiation in the inpatient setting and conducted analyses for initiation only among patients identified in the outpatient and ED settings. We checked data quality, consistency and correlations prior to statistical modeling. If two covariates were highly correlated ($r > 0.40$), only one of the variables was included in the model, based on an assessment of clinical relevance. We described patient characteristics using percentages for all variables except age (which was described by a mean with standard deviation) and Charlson/Deyo (which was also described by a median with interquartile ranges). For descriptive purposes, differences between those who initiated or engaged in treatment and those who did not were examined with Wilcoxon rank-sum tests and chi-square tests of association for interval-level and categorical variables, respectively. For our primary analyses, risk ratios (RR) were estimated from a generalized estimating equation logistic regression model using health plan as a clustering variable. All variables with a $p < 0.25$ in the bivariate analyses were considered for inclusion in the final adjusted models. Sex was included in all models due to its strong association with comorbidity. Forward selection was used to identify the other variables significantly ($p < 0.05$) associated with initiation and engagement. Variables in the final models were assessed for multi-collinearity. All analyses were performed using SAS 9.4 (SAS Software Inc, Cary, NC). In supplemental analyses, we also conducted a combined analysis examining factors associated with treatment engagement among individuals who met initiation criteria in any setting.

RESULTS

During the study period, 86,565 patients with an index AOD use disorder diagnosis were eligible for inclusion in the cohort across the seven health plans/systems. Across all index identification settings, the median Charlson/Deyo comorbidity index score was zero (IQR = 0, 1), with a range of 0 to 20 (Table 1). Nearly one third (30.6%, n = 10,276) of patients with any comorbidity received their index diagnosis of an AOD disorder in an inpatient setting.

Table 2 describes the prior-year prevalence of conditions across HCUP and SAMC diagnoses for all eligible patients. Mental disorders, including AOD abuse/dependence, was the most prevalent specified past-year HCUP category (66.2%), followed by musculoskeletal and connective tissue disorders (52.1%) and nervous system/sense organ conditions (50.8%). Injury/poisoning was the most prevalent past-year SAMC condition (35.5%), followed by hypertension (34.8%) and depression (30.4%).

Initiation of Treatment

We identified treatment initiation in 27.9% (n = 24,188) of eligible patients, of whom approximately half had an index diagnosis of alcohol use disorder (50.7%; n = 12,252); the remainder had an index diagnoses of drug use disorder (49.3%; n = 11,936; Table 1). Across all settings, those who initiated treatment were significantly older (median age 52.0 years, IQR = 35.0, 64.0) than those who did not (47.0 years, IQR = 31.0, 60.0). They were also more likely to have a diagnosis of tobacco dependence (29.5% vs. 19.5%), pregnancy/childbirth (4.2% vs. 1.5%), and one or more medical complications of substance use (injury/poisoning, cirrhosis, hepatitis C, or pancreatic disease: 40.2% vs. 24.9%) in the prior year compared to those who did not initiate. A higher proportion of those who initiated had Charlson/Deyo comorbidity index scores of two or more (33.5%) compared with those who did not initiate (21.6%).

Among patients who were identified as having an AOD diagnosis in outpatient and ED settings (n = 69,965, Table 3), Charlson/Deyo comorbidity index scores of two or more were independently associated with a reduced likelihood of initiation (score 1: RR = 0.99, 95% CI = 0.96, 1.03; score 2+ RR = 0.80, 95% CI = 0.74, 0.86; reference score = 0). Patients with a prior-year diagnosis of tobacco dependence (RR = 1.30, 95% CI = 1.17, 1.43) or alcohol abuse (RR = 1.57, 95% CI = 1.32, 1.86) were more likely to initiate treatment compared to those without these diagnoses. Further, prior-year diagnoses of cirrhosis (RR = 1.25, 95% CI = 1.12, 1.35) and pancreatic disease (RR = 1.34, 95% CI = 1.15, 1.56) were associated with higher likelihood of initiation.

Treatment Engagement

Among those who were diagnosed with AOD use disorder in any setting (outpatient, ED, or inpatient) and initiated treatment, 11.5% (n = 2,782) met HEDIS criteria for AOD treatment engagement (Table 1). Patients who engaged in AOD treatment were younger (44.0 years, IQR = 30.0, 55.0) and more likely to be non-Hispanic white (64.2%) compared to those who did not engage (median age 53.0 years, IQR = 36.0, 65.0; 61.2% non-Hispanic white). For those who engaged, the index visit type was more likely to be an outpatient visit (61.6%)

compared to those who did not engage (16.7%). Those who engaged also had less medical comorbidity (Charlson/Deyo index score of zero: 66.5% vs. 44.5%) and fewer medical complications of substance use (injury/poisoning, liver cirrhosis, hepatitis C, or pancreatic disease; 36.6% vs 40.6%).

Among patients who were identified as having an AOD diagnosis in an inpatient setting (n = 16,193; Table 4), Charlson/Deyo comorbidity scores of two or more were less likely to engage (RR = 0.70, 95% CI = 0.61, 0.79) compared to those with scores of zero. Factors associated with increased engagement included past-year alcohol dependence (RR = 2.70, 95% CI = 2.23, 3.26), depressive disorder (RR = 1.37, 95% CI = 1.23, 1.52) and major psychotic disorder (RR = 1.47, 95% CI = 1.15, 1.88).

When we examined treatment engagement only in the subset of patients who were identified in the outpatient or ED settings and subsequently initiated treatment (n = 7,963; Table 5), factors associated with decreased likelihood of engagement included Charlson/Deyo comorbidity scores of one (RR = 0.85, CI = 0.76–0.94) or two or more (RR = 0.61, CI = 0.53, 0.71, compared to those with scores of zero), being African American (RR = 0.76, 95% CI = 0.66, 0.87), and index identification in the ED setting (RR = 0.47, 95% CI = 0.42, 0.52).

Among patients who were identified as having an AOD diagnosis in any setting and initiated treatment (n = 24,188; Table 6), Charlson/Deyo comorbidity scores of one (RR = 0.87, 95% CI = 0.82, 0.93) or two or more (RR = 0.65, 95% CI = 0.58, 0.72) were less likely to engage compared to those with scores of zero. Factors associated with increased engagement included female gender (RR = 1.02, 95% CI = 1.00, 1.05), index encounter types of outpatient, ED or other (RR = 6.73, 95% CI = 5.07, 8.92; RR = 3.30, 95% CI = 2.45, 4.46; and RR = 3.40, 95% CI = 4.68, 6.89, respectively compared to inpatient index types), or a past-year diagnosis of pancreatic disease (RR = 1.23, 95% CI = 1.20, 1.26). In contrast, factors associated with reduced engagement included being African American (RR = 0.73, 95% CI = 0.63, 0.84 compared to non-Hispanic White race/ethnicity), pregnancy/childbirth (RR = 0.62, 95% CI = 0.45, 0.86) and past-year injury or poisoning (RR = 0.97, 95% CI = 0.96, 0.99).

DISCUSSION

In this large cohort of health system patients with AOD use disorders, we found that significant general medical comorbidity was independently associated with poorer adherence to HEDIS AOD treatment initiation and engagement measures. Individuals with greater comorbidity had lower rates of initiation and engagement than patients with no identified medical comorbidity (RR estimates from 0.61 to 0.90). The only medical conditions associated with higher rates of initiation and/or engagement were cirrhosis (initiation only) and pancreatic disease (initiation and engagement).

There are several potential explanations for lower initiation and engagement among individuals with comorbidities. It may be more difficult for patients with chronic illness to attend the visits required to meet initiation and engagement criteria (total of three visits

within 45 days) due to factors such as transportation problems and functional disability or pain. Further quantitative and qualitative research could help identify such barriers. Telephone or video visits or evidence-based online treatment options, not currently included in the HEDIS AOD measures, may be more convenient for individuals with significant comorbidity.[25] Additionally, consistent access to and better integration of AOD treatment and medical services may be needed.[26] One approach is to provide AOD treatment at sites where patients obtain primary and specialty medical care.[24,27] Analogous to the "medical home" model often used for HIV patient care,[28] addiction-trained behavioral health personnel for individual and group visits can be co-located in primary care clinics (i.e., collaborative care), and primary care providers and medical specialists can be trained to provide pharmacologic treatment for AOD use disorders, such as naltrexone and buprenorphine.[29] Conversely, physician, nursing, laboratory, or primary care services could be provided in AOD treatment settings by family medicine or internal medicine physicians. On-site medical care at AOD treatment settings has been associated with greater receipt of medical services and fewer ED visits and hospitalizations.[30–32]

Another factor that may have contributed to the finding that comorbidity was negatively associated with treatment initiation may be that some patients attempted to reduce AOD without seeking formal treatment services. For example, there is evidence indicating that as individuals get older and/or develop chronic medical problems, they cut back or stop consuming alcohol.[33–35] Alcohol use disorder was the most common AOD use disorder diagnosis in the sample, which included AOD use disorders of a range of severity. Therefore, it is possible that some individuals with significant health problems were motivated to reduce AOD use without initiating treatment, particularly with increasing implementation of screening and brief interventions in health systems.

It is possible that HEDIS measures at the time our study was conducted were inappropriate for patients with substantial comorbidity, as some individuals may have met initiation criteria just because they were hospitalized for medical reasons and may not have received AOD use disorder treatment in the inpatient setting. We also acknowledge that there may be situations in which it is appropriate to prioritize competing medical needs due to reasons of medical acuity or for financial reasons. However, the HEDIS measures remain valuable in helping to identify gaps in initiation and engagement for patients identified in outpatient and ED settings.

Our results suggest that certain medical conditions, such as cirrhosis and pancreatic disease, may be markers of AOD use disorder severity prompting providers to diagnose and refer patients to treatment. Further research could help determine whether providers are more effective in discussing the need for treatment in the context of certain medical conditions (e.g., pancreatitis) in contrast to other conditions (e.g., overdose or hepatitis C). Such differences could account for our variable results across conditions.

Our findings were consistent with prior studies demonstrating that health plan performance on HEDIS AOD measures is suboptimal, and provide additional evidence of the importance of setting of diagnosis on adherence to HEDIS measures, as well as racial and ethnic differences in initiation.[6,9] Our findings regarding somewhat lower engagement among

patients with pregnancy or childbirth in the prior year are concerning due to the risk of poor outcomes among neonates and the risk of suicide and unintentional overdose among women in the post-partum period.[36] These findings warrant further investigation.

Our study had several limitations. We did not examine the reasons for inpatient admission and the type of treatment (i.e., medical, psychiatric or AOD treatment) in inpatient settings. Further, the widely used performance measures we examined do not include other important dimensions of quality AOD treatment, such as receipt of medication-assisted treatment (e.g. office-based treatment with buprenorphine or naltrexone), the type of behavioral treatment provided, and the patient-centeredness of AOD use disorder treatment services. These may warrant incorporation into future HEDIS metrics.

In this study using data from multiple health plans across the United States, we found that medical comorbidity was associated with poor AOD treatment initiation and engagement. These findings help to highlight several important directions for future research and quality improvement within health systems. First, large-scale health systems data could be used to examine the association between meeting AOD performance metrics and medical outcomes such as hospitalization and mortality. Such findings could help refine quality AOD treatment metrics for patients with comorbidity. Further, 2018 HEDIS initiation and engagement measures will include medication-assisted treatment and telehealth,[37] which may improve initiation and engagement rates for individuals with comorbidity. Further quantitative and qualitative research can identify barriers to initiation and engagement at the patient, provider, health system and policy levels. Finally, interventions and programs to enhance initiation and engagement for individuals with medical comorbidity should be developed and tested.

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Table 1.

Demographic and clinical characteristics of study cohort of patients with alcohol or other drug (AOD) use disorders at seven health systems (N=86,565) stratified by AOD treatment initiation and engagement status, October 2014 through August 2015

		AOD Treatment Initiation in any setting			AOD Treatment Engagement, among those who Initiated		
Characteristic	**Total sample (N=86,565)**	**Initiated (N=24,188)**	**Did Not Initiate (N=62,377)**	**p-value**	**Engaged (N=2,782)**	**Did not engage (N=21,406)**	**p-value**
Index AOD use disorder diagnosis, n (%)				< .01			< .01
Alcohol	45050 (52.0)	12252 (50.7)	32798 (52.6)		1511 (54.3)	10741 (50.2)	
Drug	41515 (48.0)	11936 (49.3)	29579 (47.4)		1271 (45.7)	10665 (49.8)	
Age group, n (%)				< .01			< .01
18 – 25	14644 (16.9)	3585 (14.8)	11059 (17.7)		502 (18.0)	3083 (14.4)	
26 – 39	16247 (18.8)	3806 (15.7)	12441 (19.9)		652 (23.4)	3154 (14.7)	
40 – 64	38796 (44.8)	10916 (45.1)	27880 (44.7)		1391 (50.0)	9525 (44.5)	
65+	16878 (19.5)	5881 (24.3)	10997 (17.6)		237 (8.5)	5644 (26.4)	
Age, median (IQR)	49.0 (32.0, 61.0)	52.0 (35.0, 64.0)	47.0 (31.0, 60.0)	< .01	44.0 (30.0, 55.0)	53.0 (36.0, 65.0)	< .01
Sex, n (%)				0.02			0.02
Female	34268 (39.6)	9722 (40.2)	24546 (39.4)		1063 (38.2)	8659 (40.5)	
Male	52297 (60.4)	14466 (59.8)	37831 (60.6)		1719 (61.8)	12747 (59.5)	
Race/ethnicity, n (%)				< .01			< .01
White	51896 (60.0)	15086 (62.4)	36810 (59.0)		1785 (64.2)	13301 (62.1)	
Hispanic	16812 (19.4)	4129 (17.1)	12683 (20.3)		494 (17.8)	3635 (17.0)	
African American	8613 (10.0)	2610 (10.8)	6003 (9.6)		181 (6.5)	2429 (11.3)	
Other/Unknown	6189 (7.2)	1557 (6.4)	4632 (7.4)		235 (8.4)	1322 (6.2)	
Asian	3055 (3.5)	806 (3.3)	2249 (3.6)		87 (3.1)	719 (3.4)	
Index AOD diagnosis setting, n (%)				< .01			< .01
Outpatient	47909 (55.3)	5294 (21.9)	42615 (68.3)		1714 (61.6)	3580 (16.7)	
Emergency Department	22056 (25.5)	2669 (11.0)	19387 (31.1)		401 (14.4)	2268 (10.6)	
Inpatient	16486 (19.0)	16193 (66.9)	293 (0.5)		662 (23.8)	15531 (72.6)	

Characteristic	Total sample (N=86,565)	AOD Treatment Initiation in any setting: Initiated (N=24,188)	AOD Treatment Initiation in any setting: Did Not Initiate (N=62,377)	p-value	AOD Treatment Engagement, among those who Initiated: Engaged (N=2,782)	AOD Treatment Engagement, among those who Initiated: Did not engage (N=21,406)	p-value
Other	114 (0.1)	32 (0.1)	82 (0.1)		5 (0.2)	27 (0.1)	
Charlson/Deyo comorbidity index, n (%)				< .01			< .01
0	52978 (61.2)	11371 (47.0)	41607 (66.7)		1849 (66.5)	9522 (44.5)	
1	14906 (17.2)	4712 (19.5)	14906 (17.2)		485 (17.4)	4227 (19.7)	
2+	18681 (21.6)	8105 (33.5)	10576 (17.0)		448 (16.1)	7657 (35.8)	
Charlson/Deyo comorbidity index, median, IQR[a]	0 (0, 1)	1 (0, 2)	0 (0, 18)	< .01	0, (0, 1)	1 (0, 3)	< .01
AOD abuse in prior year, n (%)							
Alcohol or drug	20771 (24.0)	10471 (43.3)	10300 (16.5)	< .01	786 (28.3)	9685 (45.2)	< .01
Alcohol	12560 (14.5)	5977 (24.7)	6583 (10.6)	< .01	470 (16.9)	5507 (25.7)	< .01
Drug	10786 (12.5)	5841 (24.1)	4945 (7.9)	< .01	452 (16.2)	5389 (25.2)	< .01
AOD dependence in prior year, n (%)							
Alcohol or drug	23395 (27.0)	8861 (36.6)	14534 (23.3)	< .01	1133 (40.7)	7728 (36.1)	< .01
Alcohol	13270 (15.3)	5421 (22.4)	7849 (12.6)	< .01	716 (25.7)	4705 (22.0)	< .01
Drug	12544 (14.5)	4431 (18.3)	8113 (13.0)	< .01	600 (21.6)	3831 (17.9)	< .01
Substance-specific AOD diagnoses in prior year, n (%)							
Opioid	7987 (9.2)	2833 (11.7)	5154 (8.3)	< .01	394 (14.2)	2439 (11.4)	< .01
Cannabis	7452 (8.6)	3995 (16.5)	3457 (5.5)	< .01	279 (10.0)	3716 (17.4)	< .01
Amphetamine	3087 (3.6)	1521 (6.3)	1566 (2.5)	< .01	160 (5.8)	1361 (6.4)	0.21
Cocaine	1362 (1.6)	697 (2.9)	665 (1.1)	< .01	82 (2.9)	615 (2.9)	0.83
Barbiturate	1312 (1.5)	475 (2.0)	837 (1.3)	< .01	79 (2.8)	396 (1.8)	< .01
Hallucinogen	94 (0.1)	55 (0.2)	39 (0.1)	< .01	6 (0.2)	49 (0.2)	0.89
AOD related diagnoses in prior year, n (%)							
Drug psychosis	3261 (3.8)	1935 (8.0)	1326 (2.1)	< .01	182 (6.5)	1753 (8.2)	< .01
Alcohol psychosis	3072 (3.6)	1600 (6.6)	1472 (2.4)	< .01	262 (9.4)	1338 (6.3)	< .01

	AOD Treatment Initiation in any setting				AOD Treatment Engagement, among those who Initiated		
Characteristic	**Total sample (N=86,565)**	**Initiated (N=24,188)**	**Did Not Initiate (N=62,377)**	**p-value**	**Engaged (N=2,782)**	**Did not engage (N=21,406)**	**p-value**
Tobacco dependence	19318 (22.3)	7140 (29.5)	12178 (19.5)	< .01	767 (27.6)	6373 (29.8)	0.02
Pregnancy/childbirth	1975 (2.3)	1019 (4.2)	956 (1.5)	< .01	43 (1.5)	976 (4.6)	< .01
AOD intoxication	1176 (1.4)	591 (2.4)	585 (0.9)	< .01	78 (2.8)	513 (2.4)	0.19
Alcoholic neuropathy	231 (0.3)	94 (0.4)	137 (0.2)	< .01	15 (0.5)	79 (0.4)	0.17
Alcoholic gastritis	224 (0.3)	123 (0.5)	101 (0.2)	< .01	22 (0.8)	101 (0.5)	0.03
Toxic effect of alcohol[b]	187 (0.2)	117 (0.5)	70 (0.1)	< .01	11 (0.4)	106 (0.5)	0.48
Alcoholic cardiomyopathy	172 (0.2)	105 (0.4)	67 (0.1)	< .01	10 (0.4)	95 (0.4)	0.52
Medical complication of AOD use in prior year, n (%)							
Any	35141 (40.6)	13077 (54.1)	22064 (35.4)	< .01	1202 (43.2)	11875 (55.5)	< .01
Injury/Poisoning	30722 (35.5)	11370 (47.0)	19352 (31.0)	< .01	1015 (36.5)	10355 (48.4)	< .01
Cirrhosis	6059 (7.0)	2800 (11.6)	3259 (5.2)	< .01	310 (11.1)	2490 (11.6)	0.45
Hepatitis C	2291 (2.7)	816 (3.4)	1475 (2.4)	< .01	96 (3.5)	720 (3.4)	0.81
Pancreatic disease	2081 (2.4)	1170 (4.8)	911 (1.5)	< .01	104 (3.7)	1066 (5.0)	< .01

Abbreviations: IQR=interquartile range; AOD=alcohol or other drugs

[a] Analyzed by Wilcoxon Rank Sum

[b] Toxic effects of alcohol includes: excess blood alcohol level, poisoning by alcohol, and toxic effect of ethanol alcohol diagnoses combined

Table 2.

Among all patients with an AOD in seven health systems, prior-year prevalence of Healthcare Cost and Utilization Project (HCUP)[23] body system disease or disorder and any of 21 Substance Abuse-Related Medical Conditions (SAMC)[24]

HCUP or SAMC Description	Patients in sample with condition (N=86,565) N (%)
HCUP Classification	
Mental illness (includes AOD abuse and dependence)	57335 (66.2)
Symptoms, signs and ill-defined	55497 (64.1)
E codes (external injury and residual)	47585 (55.0)
Musculoskeletal and connective tissue	45080 (52.1)
Nervous system and sense organs	32937 (50.8)
Endocrine; nutritional; metabolic; immunity	42189 (48.7)
Circulatory	38603 (44.6)
Respiratory	33144 (38.3)
Digestive	32849 (38.0)
Injury and poisoning[a]	30722 (35.5)
Genitourinary	29144 (33.7)
Skin and subcutaneous tissue	25710 (29.7)
Infectious and parasitic disease	18564 (21.5)
Blood and blood-forming organs	14485 (16.7)
Congenital	2806 (3.2)
Pregnancy, childbirth and the puerperium[a]	1922 (2.2)
Neoplasms	1119 (1.3)
Perinatal[a]	130 (0.2)
SAMC Classification	
Injury and poisonings[a, b]	30722 (35.5)
Hypertension	30088 (34.8)
Depression	26293 (30.4)
Anxiety and nervous disorders	23705 (27.4)
Asthma	10020 (11.6)
Psychosis	9879 (11.4)
Chronic obstructive pulmonary disease	8530 (9.9)
Ischemic heart disease	6441 (7.4)
Liver cirrhosis[a]	6059 (7.0)
Pneumonia	4503 (5.2)
Acid-related disorders	3348 (3.9)
Hepatitis C[a]	2291 (2.7)

HCUP or SAMC Description	Patients in sample with condition (N=86,565) N (%)
Pancreatic diseases[a]	2081 (2.4)
Alcoholic gastritis	224 (0.3)
Toxic effects of alcohol (ethyl and unspecified)	156 (0.2)
Alcoholic neuropathy	231 (0.3)
Drug neuropathy	89 (0.1)
Alcoholic cardiomyopathy	172 (0.2)
Excess blood alcohol level	22 (0.03)
Alcohol poisoning	36 (0.04)
Drug dependence in mother-childbirth	144 (0.2)

[a]Categories considered for multivariable analysis of factors associated with initiation or engagement

[b]Category equivalent in both HCUP and SAMC classification

Table 3.

Among those identified with an alcohol or drug (AOD) use disorder in an outpatient or emergency department setting (N=69,965), characteristics associated with initiation of AOD treatment

Characteristic associated with AOD treatment initiation	Population (N=69,965) N (%) or median (IQR)	Unadjusted RR for initiation (95% CI)	Adjusted RR for initiation (95% CI)
Race/ethnicity			
White	41571 (59.4)	[Ref]	[Ref]
Asian	2502 (3.6)	0.80 (0.77–0.83)	0.80 (0.78–0.82)
African American	6653 (9.5)	0.80 (0.74–0.87)	0.80 (0.75–0.86)
Hispanic	14043 (20.1)	0.83 (0.80–0.87)	0.84 (0.80–0.87)
Other/Unknown	5196 (7.4)	0.92 (0.75–1.12)	0.93 (0.76–1.13)
Age	46.4 (17.7)	1.01 (1.00–1.01)	--
Sex			
Male	37600 (60.9)	[Ref]	[Ref]
Female	27390 (39.1)	0.92 (0.83–1.03)	0.92 (0.82–1.03)
Charlson/Deyo comorbidity index			
0	46708 (66.8)	[Ref]	[Ref]
1	11557 (16.5)	1.08 (1.02–1.13)	0.99 (0.96–1.03)
2+	11700 (16.7)	0.91 (0.86–0.96)	0.80 (0.74–0.86)
Diagnoses in the prior year			
Alcohol abuse	7824 (11.2)	1.86 (1.67–2.08)	1.57 (1.32–1.86)
Tobacco dependence	14102 (20.2)	1.37 (1.23–1.54)	1.30 (1.17–1.43)
Pregnancy/childbirth	1073 (1.5)	0.97 (0.70–1.35)	--
Injury/poisoning	22027 (31.5)	1.19 (1.07–1.32)	--
Cirrhosis	3790 (5.4)	1.36 (1.30–1.41)	1.25 (1.12–1.35)
Hepatitis C	1695 (2.4)	1.17 (1.09–1.26)	--
Pancreatic disease	1083 (1.5)	1.59 (1.43–1.77)	1.34 (1.15–1.56)

Abbreviations. IQR=interquartile range; RR = risk ratio; CI = confidence interval; AOD=alcohol or other drugs; -- indicates variables not included in adjusted analyses because they either were not significant in bivariate analyses (p-value ≥ 0.25) or forward selection modeling (p-value ≥ 0.25)

Table 4.

Among patients identified with an alcohol or drug use disorder (AOD) in an inpatient setting who initiated AOD treatment (N=16,193), characteristics associated with AOD treatment engagement

Characteristic associated with AOD treatment engagement	Identified in inpatient setting (N=16193) N (%) or Median (IQR)	Unadjusted RR for AOD engagement (95% CI)	Adjusted RR for AOD engagement (95% CI)
Race/ethnicity			
White	10012 (61.8)	[Ref]	[Ref]
Asian	549 (3.4)	1.10 (0.78–1.55)	1.22 (0.85–1.76)
African American	1941 (12.0)	0.61 (0.47–0.78)	0.68 (0.56–0.82)
Hispanic	2732 (16.9)	0.97 (0.88–1.08)	1.02 (0.93–1.13)
Other/Unknown	959 (5.9)	1.07 (0.84–1.36)	1.13 (0.91–1.42)
Age	53.0 (19.0)	0.98 (0.98–0.99)	--
Sex			
Male	9471 (58.5)	[Ref]	[Ref]
Female	6722 (41.5)	0.91 (0.78–1.08)	0.91 (0.77–1.08)
Charlson/Deyo comorbidity index			
0	6043 (37.3)	[Ref]	[Ref]
1	3273 (20.2)	0.95 (0.84–1.07)	0.90 (0.79–1.02)
2+	6877 (42.5)	0.73 (0.64–0.83)	0.70 (0.61–0.79)
Diagnoses in the prior year			
Alcohol Dependence	3843 (23.7)	2.68 (2.28–3.16)	2.70 (2.23–3.26)
Drug Dependence	2998 (18.5)	1.96 (1.79–2.15)	--
Depressive Disorder	6093 (37.6)	1.45 (1.31–1.62)	1.37 (1.23–1.52)
Major Psychotic Disorder	2823 (17.4)	1.59 (1.31–1.92)	1.47 (1.15–1.88)
Tobacco Dependence	5070 (31.3)	1.51 (1.35–1.68)	--
Hepatitis C	588 (3.6)	1.44 (1.10–1.86)	--
Pancreatic Disease	971 (6.0)	1.58 (1.44–1.74)	--

Abbreviations. IQR=interquartile range; RR = risk ratio; CI = confidence interval; AOD=alcohol or other drugs; -- indicates variables not included in adjusted analyses because they either were not significant in bivariate analyses (p-value ≥ 0.25) or forward selection modeling (p-value ≥ 0.25)

Table 5.

Among patients identified as having an AOD use disorder in an outpatient or emergency department setting and initiated treatment (N=7,963), characteristics associated with AOD treatment engagement

Characteristic associated with AOD treatment engagement	Identified in outpatient/ED setting (N=7963) N (%) or Median (IQR)	Unadjusted RR for engagement (95% CI)	Adjusted RR for engagement (95% CI)
Race/ethnicity			
White	5049 (63.4)	[Ref]	[Ref]
Asian	257 (3.2)	0.92 (0.79–1.09)	0.97 (0.80–1.18)
African American	668 (8.4)	0.72 (0.63–0.82)	0.76 (0.66–0.87)
Hispanic	1394 (17.5)	0.98 (0.89–1.07)	0.98 (0.89–1.07)
Other/Unknown	595 (7.5)	1.11 (0.95–1.29)	1.11 (0.98–1.27)
Age	46.4 (17.7)	0.99 (0.98–1.00)	--
Sex			
Male	3660 (62.5)	[Ref]	[Ref]
Female	2988 (37.5)	1.02 (0.96–1.07)	1.03 (0.97–1.09)
Index encounter setting			
Outpatient	4975 (62.5)	[Ref]	[Ref]
Emergency Department	2669 (33.5)	0.46 (0.42–0.51)	0.47 (0.42–0.52)
Charlson/Deyo comorbidity index			
0	5310 (66.7)	[Ref]	[Ref]
1	1433 (18.0)	0.81 (0.73–0.89)	0.85 (0.76–0.94)
2+	1220 (15.3)	0.58 (0.52–0.88)	0.61 (0.53–0.71)
Diagnoses in the prior year			
Tobacco dependence	2061 (25.9)	0.89 (0.81–0.98)	--
Pregnancy/childbirth	121 (1.5)	0.92 (0.74–1.15)	--
Injury/poisoning	2848 (35.8)	0.86 (0.83–0.90)	--
Cirrhosis	589 (7.4)	0.93 (0.83–1.04)	--
Hepatitis C	228 (2.9)	1.04 (0.91–1.20)	--
Pancreatic disease	199 (2.5)	0.78 (0.72–0.85)	--

Abbreviations. IQR=interquartile range; RR = risk ratio; CI = confidence interval; AOD=alcohol or other drugs; -- indicates variables not included in adjusted analyses because they either were not significant in bivariate analyses (p-value ≥ 0.25) or forward selection modeling (p-value ≥ 0.25)

Table 6.

Among patients identified with an alcohol and other drug use in any setting who initiated AOD treatment (N=24,188), characteristics associated with AOD use disorder treatment engagement

Characteristics associated with treatment engagement	Identified in any setting (N=24,188) N (%) or Median (IQR)	Unadjusted RR for engagement (95% CI)	Adjusted RR for engagement (95% CI)
Race/ethnicity			
White	15086 (62.4)	[Ref]	[Ref]
Asian	806 (3.3)	0.92 (0.79–1.08)	0.99 (0.86–1.14)
African American	2610 (10.8)	0.58 (0.46–0.72)	0.73 (0.63–0.84)
Hispanic	4129 (17.1)	0.97 (0.91–1.03)	0.97 (0.92–1.02)
Other/Unknown	1557 (6.4)	1.14 (0.91–1.44)	1.08 (0.93–1.25)
Age	50.3 (18.6)	0.98 (0.97–0.98)	--
Sex			
Female	14466 (59.8)	0.92 (0.87–0.97)	1.02 (1.00–1.05)
Male	9722 (40.2)	[Ref]	[Ref]
Index encounter setting			
Inpatient	16193 (67.0)	[Ref]	[Ref]
Outpatient	5294 (21.9)	7.75 (5.85–10.27)	6.73 (5.08–8.92)
Emergency Department	2669 (11.0)	3.73 (2.79–4.99)	3.31 (2.45–4.46)
Other	32 (0.1)	3.88 (1.90–7.93)	3.40 (1.68–6.89)
Charlson/Deyo comorbidity index			
0	11371 (47.0)	[Ref]	[Ref]
1	4712 (19.5)	0.64 (0.60–0.68)	0.87 (0.82–0.93)
2+	8105 (33.5)	0.33 (0.28–0.38)	0.65 (0.58–0.72)
Diagnosis in the prior year			
Tobacco dependence	7140 (29.5)	0.93 (0.87–0.99)	--
Pregnancy/childbirth	1019 (4.2)	0.38 (0.24–0.61)	0.62 (0.45–0.86)
Injury/poisoning	11370 (47.0)	0.65 (0.59–0.71)	0.97 (0.96–0.99)
Cirrhosis	2800 (11.6)	0.95 (0.82–1.10)	--
Hepatitis C	816 (3.4)	1.05 (0.90–1.22)	--
Pancreatic disease	1170 (4.8)	0.75 (0.68–0.81)	1.23 (1.20–1.26)

Abbreviations. IQR=interquartile range; RR = risk ratio; CI = confidence interval; AOD=alcohol or other drugs