

Acute Care Hospital Utilization Among Medical Inpatients Discharged With a Substance Use Disorder Diagnosis

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Objective: Hospital discharge may be an opportunity to intervene among patients with substance use disorders to reduce subsequent hospital utilization. This study determined whether having a substance use disorder diagnosis was associated with subsequent acute care hospital utilization.

Methods: We conducted an observational cohort study among 738 patients on a general medical service at an urban, academic, safety-net hospital. The main outcomes were *rate* and *risk* of acute care hospital utilization (emergency department visit or hospitalization) within 30 days of discharge. The main independent variable was presence of a substance use disorder primary or secondary discharge diagnosis code at the index hospitalization.

Results: At discharge, 17% of subjects had a substance use disorder diagnosis. These patients had higher rates of recurrent acute care hospital utilization than patients without substance use disorder diagnoses (0.63 vs 0.32 events per subject at 30 days, $P < 0.01$) and increased risk of any recurrent acute care hospital utilization (33% vs 22% at 30 days, $P < 0.05$). In adjusted Poisson regression models, the incident rate ratio at 30 days was 1.49 (95% confidence interval, 1.12-1.98) for patients with substance use disorder diagnoses compared with those without. In subgroup analyses, higher utilization was attributable to those with drug diagnoses or a combination of drug and alcohol diagnoses, but not to those with exclusively alcohol diagnoses.

Conclusions: Medical patients with substance use disorder diagnoses, specifically those with drug use-related diagnoses, have higher rates of recurrent acute care hospital utilization than those without substance use disorder diagnoses.

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Received for publication February 21, 2011; accepted August 8, 2011.

Supported by Agency for Healthcare Research and Quality grants 1UC1HS014289-01 and 1U18HS015905-01 (Dr Jack) and National Heart, Lung, and Blood Institute, National Institutes of Health, grant 1 R01 HL081307-01 (Dr Jack). AHRQ and NHLBI had no further role in study design; in the collection, analysis, and interpretation of data; in the writing of the report; or in the decision to submit the paper for publication.

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ISSN: 1932-0620/12/0601-0050

DOI: 10.1097/ADM.0b013e318231de51

Key Words: hospital discharge, rehospitalization, substance use disorders, utilization

(*J Addict Med* 2012;6: 50–56)

Beginning in 2009, the Centers for Medicare & Medicaid Services started requiring all hospitals to regularly report 30-day hospital readmission rates because of the recognition that among medical patients, subsequent emergency department visits and rehospitalization are expensive and potentially preventable events (Zook et al., 1980; Frankl et al., 1991; Friedman and Basu, 2004; Jencks et al., 2009). The Patient Protection and Affordable Care Act of 2010 (United States Congress, 2010) includes several mechanisms to incentivize hospitals to decrease the rates of avoidable rehospitalization. Specifically, the value-based purchasing program beginning in the fourth quarter of 2012 will use the Centers for Medicare & Medicaid Services data to withhold reimbursement from hospitals with high rates of readmission (US Congress, 2010). The rules for this program include adjustment for medical comorbidities, but no provisions are made for adjustment on the basis of substance use or mental health comorbidity (US Department of Health and Human Services, 2010). Known risk factors for readmission include prior hospitalization, advanced age, severity of illness, length of stay, low socioeconomic status, depression, health literacy, poor coordination between inpatient and outpatient care, and absence of physician follow-up (Phillips et al., 1987; Weissman et al., 1994; Librero et al., 1999; van Walraven et al., 2002; Kartha et al., 2007; Jasti et al., 2008; Capelastegui et al., 2009; Mitchell et al., 2010).

Substance use might be an additional factor undermining discharge planning and leading to the need to return for acute care services (Strunin et al., 2007). Substance use disorders are generally associated with high rates of emergency department visits and inpatient hospitalizations (Stein et al., 1993; Cherpitel, 2003; Masson et al., 2004; Rockett et al., 2005). The problem of rehospitalizations among patients with substance use has been examined in specific populations and has shown mixed results. Several studies of psychiatric inpatients have demonstrated higher rates of rehospitalization among patients with both alcohol and drug use disorders than among those without substance use disorders (Bimerew et al., 2007; Lin et al., 2007; Prince et al., 2008, 2009). One retrospective study of AIDS patients admitted for pneumonia before the availability

of antiretroviral therapy identified crack cocaine use, but neither injection drug use nor alcoholism, as a strong predictor of rehospitalization (Grant et al., 1999). Another study, conducted after the availability of antiretroviral therapy, found no association between injection drug use and rehospitalization (Palepu et al., 2003b). A prospective cohort study among 144 medical inpatients did not find a significant association between alcohol or drug use disorders on screening instruments and rehospitalization, although the frequency of drug use disorders was low (Kartha et al., 2007). In studies among patients with known drug use disorders, engagement in addiction and medical care treatment has been associated with lower rehospitalization rates (Laine et al., 2001) and repeated emergency department use (Laine et al., 2005). Several previous intervention trials targeting rehospitalization among medical patients either have usually excluded subjects with alcohol or drug use (Hughes et al., 2000; Fine et al., 2003; Stone et al., 2005) or have not examined it as a potentially contributing factor (Evans and Hendricks, 1993; Fitzgerald et al., 1994; Siu et al., 1996; Naylor et al., 1999; Andersen et al., 2000; Dudas et al., 2001; Phillips et al., 2004; Shepperd et al., 2004; Holland et al., 2005; Coleman et al., 2006; Balaban et al., 2008).

Project RED (re-engineered discharge), a randomized trial of reengineered discharge services in 738 hospitalized general medical patients, demonstrated reduced hospital utilization and reduced costs within 30 days of discharge with a package of predischarge services, a patient-centered comprehensive after-hospital care plan, and a postdischarge follow-up phone call with a clinical pharmacist (Jack et al., 2009). We used data from this study to determine whether substance use disorder diagnoses were associated with recurrent acute care hospital utilization (either emergency department visits and/or rehospitalization).

METHODS

Study Design and Population

To determine whether a substance use diagnosis during an acute medical hospitalization is associated with recurrent acute care hospital utilization, we conducted an observational cohort study, using data collected for the Project RED study, which has been described in detail (Jack et al., 2009). Project RED was a randomized, controlled trial of a package of services to improve the discharge process and included 738 adults (age ≥ 18 years), admitted to the medical teaching service of Boston Medical Center in Boston, Massachusetts, from January 2006 through October 2007. Patients had to have a telephone, plan to live in the United States after discharge, and be able to provide informed consent in English. Patients were excluded if they were on hospital precautions or suicide watch, transferred from another medical facility, admitted for a planned procedure, or were deaf or blind. This study was approved by the institutional review board of Boston Medical Center, and all patients provided informed consent.

Data Collection and Measures

Data were collected via private in-person interviews at study recruitment during the index hospitalization. Follow-up

utilization was determined by querying the Boston Medical Center electronic medical record at 30 days after discharge. A telephone interview was conducted at 30 days after discharge to inquire about any inpatient utilization outside the Boston Medical Center system and the discharge and follow-up care process.

The primary independent variable of interest was presence of a substance use disorder defined by discharge the *International Classification of Diseases, Ninth Revision (ICD-9)* diagnosis code for the index hospitalization. Discharge diagnostic codes were assigned by the treating physicians who authored each discharge summary. We searched both primary and secondary discharge codes. Each discharge record could include up to 4 primary diagnosis codes and an unlimited number of secondary codes. Diagnostic codes included 303 (alcohol intoxication and dependence), 305.0 (alcohol abuse), 291 (alcohol-induced mental disorders), 304 (drug dependence), 305.2 to 305.7, 305.9 (drug abuse), and 292 (drug-induced mental disorders). For exploratory analyses, the substance use disorders variable was split into 3 categories: alcohol diagnosis only, drug diagnosis only, and concurrent alcohol and drug diagnoses.

The main outcomes of interest were as follows: (1) *rate* of recurrent acute care hospital utilization—defined as the total number of emergency department visits and rehospitalizations per subject within 30 days of the index discharge and (2) *risk* of recurrent acute care hospital utilization—defined as the proportion of subjects with an emergency department visit or rehospitalization within 30 days of the index discharge. An emergency department visit that led to a rehospitalization was counted only once as a rehospitalization. This outcome was determined by medical record review for utilizations occurring at Boston Medical Center and the 30-day phone interview for utilizations elsewhere. For the 30-day phone interview, 86% of the subjects were contacted (Jack et al., 2009). Self-report has demonstrated reliability for hospitalization events (Weissman et al., 1996; Wolinsky et al., 2007).

To describe this sample and to control for potential confounding in multivariable models, we assessed covariates with known associations with rehospitalization in prior studies or that we suspected clinically may be associated. Covariates that were collected by interview at recruitment included age, sex, race/ethnicity, having a primary care physician, depression symptoms, homelessness in the last 3 months, and employment. Covariates that were collected via medical record review included insurance status and the Charlson Comorbidity Index score. Project RED group assignment was also recorded. Depression was determined using the Depression subscale of the Patient Health Questionnaire-9: 9-item 4-point Likert scale, standard scoring algorithm to screen for major depression and depressive symptoms (Kroenke et al., 2001). For the insurance covariate, Free Care refers to a Massachusetts state program for uninsured patients who are not eligible for Medicaid. The Charlson Comorbidity Index was used to reflect patients' level of comorbid illnesses. The Charlson Index has been validated to predict risk of mortality on the basis of 22 disease conditions (Charlson et al., 1987).

Analyses

For descriptive purposes, all independent variables of interest were stratified by substance use disorder status. Comparisons in Table 1 were conducted using *t* tests for continuous variables and χ^2 tests for categorical variables.

Poisson and binomial regression models were used, respectively, to examine the association of a substance use disorder with *rate* (number of events per subject) and *risk* (proportion of subjects with any event) of acute care hospital utilization. Poisson regression accommodates recurrent outcomes over follow-up, allowing for calculation of incident rate ratios. Model fit was assessed by calculating deviances that were no greater than 1.06. We conducted these models with the inclusion of all covariates mentioned earlier, except race/ethnicity and group assignment. Race/ethnicity was not included in adjusted models because this variable had a similar distribution in both groups. Charlson Comorbidity Index score was included because, while not associated statistically with substance use disorder, medical comorbidities are a known important strong predictor of rehospitalization (Jasti et al., 2008; Capelastegui et al., 2009). To determine whether any association between substance use disorder and utilization was modified by assignment to the Project RED intervention, additional models were also adjusted for group assignment, and models including an interaction term between Project RED assignment and substance use diagnosis. As a secondary analysis, to explore the relative contributions from alcohol disorders and

drug disorders, an additional set of models was constructed for 3 subsets of the population with substance use disorder diagnoses (alcohol disorder only, drug disorder only, both alcohol and drug disorder) and was each compared with subjects with no substance use disorders.

All analyses were performed using S-Plus, version 8.0 (Insightful, Seattle, Wash).

RESULTS

Among 738 subjects in the Project RED cohort, 123 (17%) subjects had at least one substance use discharge diagnosis. Characteristics of the cohort, stratified by substance use disorder status, are shown in Table 1. Subjects with a substance use disorder were more likely to be male, have Medicaid, be unemployed or disabled, be homeless, and screen positive for major depression. They were less likely to have a primary care physician at enrollment.

Subjects with substance use disorders had higher rates of acute care service reutilization, including ED visits and rehospitalizations, at 30 days. The proportions of subjects who were rehospitalized or visited the ED were also higher (Table 2).

In models adjusted for age, sex, depressive symptoms, having a primary care physician, insurance, homelessness in the last 3 months, employment, and the Charlson score, the incidence rate ratios for overall acute care reutilization and rehospitalization, but not ED visits, remained statistically

TABLE 1. Characteristics of Project RED Study Participants

Characteristics	No Substance Use (n = 615)	Substance Use (n = 123)	P
Age in yr, mean (SD)	50.2 (15.8)	47.8 (11.4)	0.06
Sex, no. (%)			
Male	287 (47%)	80 (65%)	<0.01
Race,* no. (%)			0.91
White non-Hispanic	168 (27%)	37 (30%)	
Black non-Hispanic	326 (53%)	60 (49%)	
Hispanic	60 (10%)	14 (11%)	
Other race or mixed race	13 (2.1%)	3 (2.4%)	
Health insurance, no. (%)			<0.01
Private	108 (18%)	11 (9.0%)	
Medicaid	274 (45%)	82 (67%)	
Medicare	89 (15%)	9 (7.4%)	
Free Care†	137 (23%)	20 (16%)	
Current employment status, no. (%)			<0.01
Full-time	159 (26%)	19 (5.0%)	
Part-time	77 (13%)	10 (8.1%)	
Retired	116 (19%)	15 (12%)	
Disabled	124 (20%)	40 (33%)	
Unemployed	106 (17%)	36 (29%)	
Other	29 (4.7%)	3 (2.4%)	
Homeless in last 3 months, no. (%)	51 (8.1%)	24 (20%)	<0.01
PCP at enrollment, no. (%)	506 (82%)	89 (72%)	0.01
Major depression,‡ no. (%)	85 (14%)	35 (29%)	<0.01
RED intervention group, no. (%)	313 (51%)	57 (46%)	0.36
Charlson comorbidity score, mean (SD)	1.2 (1.9)	1.3 (2.2)	0.61
Length of stay in days, mean (SD)	2.7 (3.2)	2.6 (2.5)	0.82
Alcohol use diagnosis only	—	54 (44%)	—
Drug use diagnosis only	—	52 (42%)	—
Alcohol and drug diagnoses	—	17 (14%)	—

*Not all column percentages sum to 100% because of missing values.

†Free Care is a means-tested Massachusetts state program for patients not eligible for Medicaid.

‡Determined using Patient Health Questionnaire (PHQ-9): 9-item 4-point Likert scale, standard scoring algorithm to screen for major depression and depressive symptoms.

PCP indicates primary care physician; RED, re-engineered discharge.

significant (Table 3). The odds ratios for the 30-day risk of utilization were higher in subjects with substance use diagnoses but not statistically significant. Adding Project RED group assignment to the models did not change the findings. In addition, the interaction term for Project RED group assignment and substance use diagnosis was not significant (data not shown).

To assess the relative contributions of alcohol and drug diagnoses to the associations with acute care hospital reutilization, we ran models with subcategories of substance use diagnoses (Table 4). The group with exclusively an alcohol diagnosis did not have a higher rate or risk of reutilization at 30 days in adjusted models. For the patients with exclusively a drug diagnosis, the rate and risk of reutilization at 30 days was higher and statistically significant. For the patients with both drug and alcohol diagnoses, the rate and risk of reutilization were higher, but statistically significant only for the rate of reutilization.

DISCUSSION

Within the Project RED cohort of general medical patients, 17% had a substance use diagnosis recorded upon discharge. Subjects with a substance use diagnosis were more likely to reutilize the emergency department or inpatient hospital and reutilized the emergency department or inpatient hospital more often at 30 days than those without a substance use diagnosis. In analyses adjusted for known reutilization risk factors, these associations were attenuated, yet sustained for the rate of reutilization. In subgroup analyses, these associations were attributable to subjects with drug only or drug and

alcohol diagnoses and not because of subjects with exclusively an alcohol diagnosis.

By demonstrating that patients with substance use diagnoses, specifically drug use diagnoses, have higher acute care hospital reutilization, this study demonstrates the need for tailored reengineered discharge programs that could augment Project RED services and further reduce subsequent utilization among patients with substance use disorders. The Project RED intervention did not include any discharge planning services tailored specifically to substance users. Previous research, among patients with substance use disorders, has demonstrated that factors affecting acute care hospital utilization include co-occurring medical and mental health conditions, engagement in primary care, and substance use treatment (Stenbacka et al., 1998; Parthasarathy et al., 2001; Weisner et al., 2001; Palepu et al., 2003a; Saxon et al., 2006; Gourevitch et al., 2007; Stecker et al., 2007). Services tailored to the needs of substance users could include initiation of addiction pharmacotherapy during hospitalization and facilitated linkage to outpatient mental health, medical, and addiction treatment (Shanahan et al., 2010).

Discharge interventions targeting specific patient populations have been shown to be effective and cost saving for patients with geriatric, stroke, and congestive heart failure. (Naylor et al., 1999; Andersen et al., 2000; Phillips et al., 2004; Coleman et al., 2006). In the setting of U.S. Preventive Services Task Force (2004), recommendations to provide screening and behavioral counseling for unhealthy alcohol use in primary care settings and the Substance Abuse Mental Health Services Administration's efforts to expand screening and brief

TABLE 2. Crude Rates and Risks of Recurrent Acute Care Hospital Utilization Within 30 Days After Index Hospitalization

	No Substance Use (n = 615)	Substance Use (n = 123)	P
Rates of reutilization			
Acute care reutilizations*: no. visits/patient/30 days	0.32	0.63	<0.01
ED visits: no. visits/patient/30 days	0.16	0.37	0.02
Rehospitalization: no. visits/patient/30 days	0.16	0.26	0.09
Risks of reutilization			
Subjects with any acute care reutilization* in 30 days	38%	52%	<0.01
Subjects with any ED visit in 30 days	23%	34%	<0.01
Subjects with any rehospitalization in 30 days	23%	33%	0.02

*Defined as sum of emergency department visits plus rehospitalizations. Note that an emergency department visit that leads to a rehospitalization is counted only as a rehospitalization. ED indicates emergency department.

TABLE 3. Adjusted Incident Rate Ratio (IRR) and Odds Ratios (OR) for the Rates and Risks of Recurrent Acute Care Hospital Utilization Within 30 days After Index Hospitalization

	Adjusted IRR (95% CI)*	
	No Substance Use Diagnosis (n = 615)	Substance Use Diagnosis (n = 123)
Rates of reutilization		
Acute care reutilizations†: no. visits/patient/30 days	Ref	1.49 (1.12-1.98)
ED visits: no. visits/patient/30 days	Ref	1.42 (0.97-2.07)
Rehospitalization: no. visits/patient/30 days	Ref	1.60 (1.04-2.46)
Risks of reutilization		
	Adjusted OR (95% CI)†	
Subjects with any acute care reutilization† in 30 days	Ref	1.38 (0.88-2.17)
Subjects with any ED visit in 30 days	Ref	1.22 (0.70-2.12)
Subjects with any rehospitalization in 30 days	Ref	1.71 (1.00-2.94)

*Covariates for adjustment include age, sex, depressive symptoms, having a PCP, insurance, homelessness in the last 3 months, employment, and the Charlson score.

†Defined as sum of emergency department visits plus rehospitalizations. Note that an emergency department visit that leads to a rehospitalization is counted only as a rehospitalization. ED indicates emergency department.

TABLE 4. Adjusted Incident Rate Ratio (IRR) and Odds Ratios (OR) for the Rate and Risk of Recurrent Acute Care Hospital Utilization Within 30 Days After Index Hospitalization Among Patients With Alcohol Only, Drug Only, and Both Alcohol and Drug Diagnoses Compared With Patients Without Substance Use Diagnoses

		Adjusted IRR (95% CI)*			
		No Substance Use Diagnosis (n = 615)	Alcohol Diagnosis Only (n = 54)	Drug Diagnosis Only (n = 52)	Both Alcohol and Drug Diagnoses (n = 17)
Rate of reutilization					
Acute care reutilizations†: no. visits/patient/30 days	Ref		1.00 (0.64-1.57)	1.78 (1.23-2.56)	2.17 (1.29-3.67)
Risk of reutilization					
Subjects with any acute care reutilization† in 30 days	Ref		0.82 (0.41-1.66)	1.97 (1.06-3.63)	1.91 (0.69-5.24)

*Covariates for adjustment include age, sex, depressive symptoms, having a PCP, insurance, homelessness in the last 3 months, employment, and the Charlson score.

†Defined as sum of emergency department visits plus rehospitalizations. Note that an emergency department visit that leads to a rehospitalization is counted only as a rehospitalization.

interventions for alcohol and drug misuse in many health care settings, including inpatient settings (Madras et al., 2009), it is likely that substantially more inpatients will be identified with substance use disorders and targeted for brief interventions. However, studies of brief interventions alone for substance use in inpatients have found little or no effects on substance use outcomes (Saitz et al., 2007; Freyer-Adam et al., 2008; McQueen et al., 2009), except in alcohol-using trauma patients. One trial found a strong effect of brief interventions for alcohol use on rehospitalization among trauma patients with alcohol use (Gentilello et al., 1999), whereas another trial did not find an effect (Sommers et al., 2006). For the medically ill inpatient with a substance use disorder, it may be more effective for interventions to focus on engagement in integrated outpatient medical and addiction care (Laine et al., 2001, 2005) to reduce inpatient utilization and fulfill the medical discharge plan.

The results of the subgroup analyses demonstrating an association with drug-only and drug and alcohol disorders, but not alcohol-only disorders, were unexpected. Drug use disorders may have medical complications that are more acutely manifested in a 30-day period, whereas the chronic nature of the medical complications of alcohol use may require longer follow-up to detect utilization differences. Also, the sensitivity of discharge diagnoses among medical inpatients likely varies between alcohol and drug users. Although the general hospitalized population is more likely to have an alcohol use disorder than a drug use disorder, approximately equal numbers of subjects were classified this way via discharge diagnoses (Table 1). Patients with recognized alcohol use disorders may be more likely than patients with drug use disorders to be admitted to the trauma service than the medicine service. A similar distribution of alcohol and drug disorders has been seen in another study that defined substance use on the basis of diagnostic codes. A cohort study of 129,524 Medicaid enrollees with a mood disorder, where substance use disorder was measured by discharge diagnoses, categorized more subjects with drug use disorders than alcohol disorders (13% vs 6%) and the risk of psychiatric rehospitalization at 90 days was higher for both alcohol and drug use disorders (adjusted hazards ratio of 1.46 and 1.58, respectively, Prince et al., 2009). To better understand the absence of effect for alcohol use disorders

in the subanalyses, a larger study with multiple measures of substance use disorder is needed.

This study has several strengths and limitations. We conducted both subject- and event-level analyses, which showed that patients with substance use disorders were more likely to return to the emergency department or inpatient hospital and they returned more often. The subjects, while limited to 1 large academic medical center, included general medical patients with relatively few restrictions compared with previous discharge studies that have focused on medical patients with specific age limits, diagnoses, or psychiatric patients.

The measures of substance use disorders were from discharge *ICD-9* codes, a crude measure prone to misclassification, yet a practical measure that is universally available for discharged patients (O'Malley et al., 2005). This method most likely underreported the number of patients with substance use disorders. A study conducted 5 years earlier that screened 986 general medical patients in the same hospital found 28% of inpatients with an alcohol use disorder by screening, yet only 16% had an alcohol-related diagnosis on medical record review (Saitz et al., 2006). In this study, using *ICD-9* codes only, we found 10% with alcohol-use-related diagnoses. Furthermore, patients in long-term remission may have carried a substance use disorder diagnosis with them, even though it was not active and contributing to any reutilization. As with the underreporting of active substance use, the underreporting of remitting substance use would bias our findings toward not finding an association.

The outcomes were based on self-report and the electronic medical record at 30 days. Each method alone has its limitations, which we mitigated by using both. Previous studies of patient self-report of hospital utilization have demonstrated high concordance with billing databases and chart review (Weissman et al., 1996; Wolinsky et al., 2007). This study may have underestimated the utilization among substance users because it did not specifically measure non-medical subsequent utilizations such as admissions to psychiatric hospitals and detoxification programs that are likely to be more common among subjects with substance use diagnoses. Stronger focus on these admissions would have likely shown an even stronger association between substance use disorder

diagnoses and recurrent acute care utilization. A reengineered discharge intervention tailored to substance users could be an opportunity to reduce not only acute medical care utilization but also utilization of acute psychiatric and detoxification programs. We also did not account for discharges against medical advice, which among patients with alcohol-related disorders have been demonstrated to result in the underestimation of the impact of alcohol-related disorders on resource utilization (Saitz et al., 2000). A tailored intervention for substance users should be implemented early to address the increased possibility of leaving against medical advice.

CONCLUSIONS

In this study, we found that medical inpatients with substance use disorder diagnoses, specifically drug use disorder diagnoses, have higher rates of recurrent acute care hospital utilization. Our study provides evidence that substance use disorder diagnoses should be considered when implementing the new regulations and accountability measures by the Centers for Medicare & Medicaid Services under PPACA 2010 health care reform. These findings are important for policy makers, insurance companies, hospitals, and physicians to consider as they develop incentives, policies, and interventions to reduce rehospitalization.

ACKNOWLEDGMENTS

Walley, Paasche-Orlow, and Jack conceived and designed the study. Lee and Chetty undertook the statistical analyses. Walley wrote the first draft of the manuscript and managed the submission. All authors contributed to the writing and editing of the final manuscript and have approved it.

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