

**ABSTRACT:** Alcohol and drug abuse continue to be major causes of morbidity and mortality and have significant social and economic ramifications. Studies have shown that for every \$1 spent on substance use disorder treatment, \$4 are saved on healthcare costs. Characterizing the healthcare resource utilization of these patients may shed light on the burden of disease and opportunities for intervention. A retrospective chart review of all patients admitted to the ICU between July 1, 2017 and December 31, 2017 was completed. Variables regarding demographic and clinical characteristics as well as healthcare resource utilization were collected. Of 737 admissions to the ICU, 158 (21%) were due to acute or chronic complications of alcohol or drug abuse. Even though alcohol and drug users were significantly younger (average age 50 years) than the general ICU cohort (average age 66 years), resource utilization was similar between these patients. The median length of stay in the ICU was similar. The number of patients transferred to in-patient rehab was low (8%), and all of those were due to comorbid psychiatric illness. The total hospital charges for the alcohol and drug abuse cohort was over 7 million dollars for the 6 months observed. A significant number of patients had at least one ER visit (49%) during the previous year, and most of these had numerous visits. ICU resource utilization by patients with acute and chronic sequelae of drug or alcohol abuse disorders continues to be high. These patients utilize resources at rates similar to an older group with other disease processes. Patients are unlikely to receive intervention for their disorder unless they have a comorbid psychiatric illness. Patients admitted to the ICU with alcohol or drug-related illness were frequently seen in the ER or were admitted to the hospital in the year prior to ICU admission, providing opportunities for intervention.

**KEYWORDS:** alcohol abuse, drug abuse, resource utilization, substance abuse

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## Introduction

Alcohol and drug abuse are major public health concerns and account for significant healthcare costs and hospital resource utilization. Across the country there has been an increase in the incidence of drug overdoses and this has been the focus of many articles in the popular press and medical literature. Unintentional drug overdose is the primary cause of injury-related death in the United States.<sup>1</sup> It is the third leading cause of premature death in New York City<sup>2</sup> and the third leading cause of preventable death nationally.<sup>3</sup> In a recent study in New York City, acute drug intoxication (including alcohol) accounted for 19% of ICU admissions<sup>4</sup>; internationally, published rates range from 3% to 14%.<sup>5–8</sup> In addition to sequelae of acute overdose, there are substantial morbidities related to chronic drug and alcohol misuse that also contribute to ICU utilization, such as gastrointestinal bleeding due to alcoholic cirrhosis.

Healthcare costs resulting from alcohol and drug overdose treatment are also rising.<sup>9</sup> A comprehensive report looking at ICU utilization in 1993 showed that of 435 ICU admissions, 14% were tobacco-related and generated 16% of ICU costs, 9% of admissions were alcohol-related and generated 13% of ICU costs and 5% were illicit drug-related and generated 10% of ICU costs.<sup>10</sup> More recent studies examining the economic impact of these types of admissions have not been conducted.

Although alcohol- and drug-related admissions to the ICU are common, relatively little scientific literature, especially recently, has been published characterizing this population. Specifically, use of ICU resources for chronic alcohol- and

drug-related problems, such as complications stemming from cirrhosis of the liver, have not been sufficiently described. The current project helps to better characterize the problems facing the healthcare system with the hope of generating interventions for decreasing resource utilization. Specifically, this study describes the clinical and epidemiological characteristics and the healthcare resource utilization of patients admitted to the ICU for alcohol- and drug-related events as compared to ICU patients admitted for other reasons.

## Methods

### *Participants and procedure*

This study was conducted at a community hospital caring for an ethnically diverse, low-income population in New York City. A prospective registry of all consecutive patients admitted to the ICU service is kept, which includes primary diagnosis and whether the admission was drug- or alcohol-related. Overall, the ICU population had a mean age of 60 years and was around 55% male. Only 40% of admitted patients were born in the United States, Canada and Mexico, with an additional 28% coming from the Caribbean and South America. The current study was a retrospective chart review of patients who were admitted to the ICU service between July 1, 2017 and December 31, 2017. Clinical and demographic characteristics were collected for all patients. In addition, a set of alcohol and drug specific variables were collected for those patients with admissions related to alcohol or drug abuse (see Tables



Table 1. ICU patient characteristics.

	WHOLE GROUP	ALCOHOL/DRUG (N = 158)	OTHER (N = 565)	TEST STATISTIC	P-VALUE
Age, mean (SD)	62.4 (17.7)	50.2 (13.4)	65.8 (17.2)	$T=10.5$	<.001
Gender, male	409 (56.6%)	121 (76%)	288 (51%)	$\chi^2=32.9$	<.001
Birth region				$\chi^2=4.66$	.32
United States, Canada and Mexico	287 (39.7%)	59 (37%)	228 (40%)		
Caribbean	114 (15.8%)	19 (12%)	95 (17%)		
South America	88 (12.2%)	24 (15%)	64 (11%)		
Southern Asia	47 (6.5%)	13 (8%)	34 (6%)		
Other	70 (9.6%)	17 (11%)	53 (10%)		
Missing	117 (16.2%)	26 (16%)	91 (16%)		
Insurance				$\chi^2=77.7$	<.001
Commercial Medicare	161 (22%)	10 (6%)	151 (27%)		
Commercial Medicaid	129 (18%)	53 (34%)	76 (14%)		
Medicare	178 (25%)	19 (12%)	159 (28%)		
Medicaid	93 (13%)	33 (21%)	60 (11%)		
Commercial	125 (17%)	34 (22%)	91 (16%)		
No coverage	23 (3%)	7 (4%)	16 (3%)		
Other	14 (2%)	2 (1%)	12 (2%)		
Intubation	293 (40.5%)	69 (44%)	224 (40%)	$\chi^2=0.83$	.36
Transfusion	240 (33.2%)	48 (30%)	192 (34%)	$\chi^2=0.74$	.39
Transfusions, mean	1.3 (2.9)	1.3 (2.5)	1.3 (3.1)	$\chi^2=0.14$	.89
Endoscopy	111 (15.4%)	29 (18%)	82 (15%)	$\chi^2=1.40$	.24
Vasopressors	216 (29.9%)	35 (22%)	181 (32%)	$\chi^2=5.76$	.02
Surgery	45 (6.2%)	5 (3%)	40 (7%)	$\chi^2=3.24$	.07
CT scan	500 (69.2%)	99 (63%)	401 (71%)	$\chi^2=4.00$	.05
CT scans, mean	1.5 (1.7)	1.2 (1.5)	1.6 (1.7)	$t=2.54$	.01
Median LOS (IQR), ICU	3.0 (2.0, 5.0)	3.0 (2.0, 5.0)	3.0 (2.0, 5.0)		
Mean LOS (SD), ICU	4.8 (5.2)	4.0 (3.0)	5.0 (5.7)	$t=2.20$	.03
Median LOS (IQR), hospital	7.0 (4.0, 13.0)	6.0 (4.0, 11.0)	8.0 (5.0, 14.0)		
Mean LOS (SD), hospital	10.7 (10.6)	8.6 (8.1)	11.3 (11.2)	$t=2.78$	.006
Median cost per stay* (IQR)	\$40688 (\$21934, \$69598)	\$30206 (\$19517, \$60470)	\$41941 (\$23151, \$71254)		
Mean cost per stay (SD)	\$57498 (\$61800)	\$45200 (\$40055)	\$60900 (\$66242)	$t=2.85$	.005
Median cost per day (IQR)	\$5061 (\$3993, \$5061)	\$5006 (\$3799, \$6407)	\$5068 (\$4079, \$6620)		
Mean cost per day (SD)	\$5867 (\$3721)	\$5825 (\$4111)	\$5850 (\$3608)	$t=-0.22$	.83

(Continued)

**Table 1.** (Continued)

	WHOLE GROUP	ALCOHOL/DRUG (N = 158)	OTHER (N = 565)	TEST STATISTIC	P-VALUE
Disposition				$\chi^2 = 64.97$	<.001
Home	305 (42%)	85 (54%)	220 (39%)		
Hospice	61 (9%)	6 (4%)	55 (10%)		
In-patient rehab	43 (6%)	13 (8%)	30 (5%)		
Transfer to other facility	26 (4%)	4 (3%)	22 (4%)		
AMA	25 (3.5%)	14 (9%)	11 (2%)		
Expired	120 (17%)	18 (11%)	102 (18%)		
Skilled nursing facility	136 (19%)	12 (8%)	124 (22%)		
Shelter/homeless	7 (1%)	6 (4%)	1 (<1%)		

\*Total cost of alcohol/drug admissions: \$7,141,600.

**Table 2.** Alcohol abuse patient clinical characteristics\*.

	N = 126
Past abuse	24 (19%)
Current abuse	102 (81%)
Acute sequelae of alcohol abuse (may be >1)	
Intoxication	54 (42%)
Withdrawal/DTs	67 (53%)
Withdrawal seizure	12 (10%)
Gastritis/upper GI bleed	54 (42%)
Pancreatitis	15 (12%)
Alcoholic hepatitis	30 (24%)
Rhabdomyolysis	32 (25%)
Cardiac arrhythmias	5 (4%)
Anoxic brain injury	6 (5%)
Aspiration pneumonia	4 (3%)
Alcohol-related trauma	7 (6%)
Respiratory failure	54 (43%)
Chronic sequelae of alcohol abuse (may be >1)	
Cirrhosis w/variceal bleed	22 (18%)
Cirrhosis w/ascites & SBP	4 (3%)
Hepatic encephalopathy	18 (14%)
Liver failure	28 (22%)
Hepato-renal syndrome	2 (2%)
Other sequelae	29 (23%)

\*Some patients had combined alcohol- and drug-related admissions.

1-3). Descriptive statistics were used to characterize patients. t-Tests and chi-square tests were used to determine differences in characteristics between alcohol and drug abuse patients and other types of admissions. This study was approved by the local Institutional Review Board.

## Results

Of 737 admissions to the ICU, 158 (21%) were due to acute or chronic complications of alcohol or drug abuse. Table 1 describes the demographic characteristics and resource utilization of patients with drug and alcohol-related admissions and other ICU patients. Alcohol and drug users were significantly more likely to be male than other ICU patients (76% versus 51%). Even though alcohol and drug users were significantly younger (average age 50 compared to 66 years), resource utilization was similar between these patients and the general ICU cohort in terms of intubations, transfusions and endoscopies. However, they were less likely to require vasopressors or CT scans. A large proportion of alcohol and drug abuse patients were covered by Medicaid or a Medicaid managed care plan (55%). Mean cost per day was similar between groups, though the mean cost of hospitalization was significantly less. The mean total cost of hospitalization for the alcohol and drug abuse patients during this 6-month period was over \$7,000,000. The median length of stay in the ICU was the same for these patients as for other ICU patients, however total mean hospitalization stay was significantly shorter in patients with alcohol and drug abuse, presumably the reason for lower total hospital costs. Significantly more alcohol and drug abuse patients were discharged home or signed out AMA compared to other ICU patients, who were more likely to go to skilled nursing facilities or hospice. The number of alcohol and drug abuse patients transferred to in-patient rehab was low (8%), and all of those were due to comorbid psychiatric illness.

**Table 3.** Drug abuse patient clinical characteristics\*.

N = 63	
Past abuse	21 (33%)
Current abuse	42 (67%)
Drug types (may be >1)**	
Cocaine	22 (30%)
Opioids	23 (31%)
Cannabinoids	22 (30%)
Synthetic cannabinoids	0 (0%)
Hallucinogens	2 (1%)
Prescription and OTC	9 (4%)
Benzodiazepines	14 (7%)
Unknown drug	6 (5%)
Other stimulant	6 (5%)
Admission reason (may be >1)	
Acute overdose	47% (72%)
Respiratory failure	37 (57%)
Seizure	7 (11%)
Rhabdomyolysis	17 (27%)
ICH	5 (8%)
Other pulmonary complications of cocaine	3 (5%)
Endocarditis/bacteremia	3 (5%)
Cardiac arrhythmias	2 (3%)
Acute Renal Failure	10 (15%)
Anoxic brain injury	3 (5%)
Other	16 (24%)

\*Some patients had combined alcohol- and drug-related admissions.

\*\*Based on urine toxicology and self-report.

Table 2 describes the clinical characteristics of patients admitted with alcohol abuse-related problems. Active drinkers constituted 81% of alcohol disorder patients. Admissions related to active alcohol use, including acute alcohol intoxication (42%), alcohol withdrawal and delirium tremens (54%), were the most common reasons for ICU admission. Upper GI bleed/gastritis was seen in 42% of patients. Respiratory failure was present in 43% of patients. In addition to these acute problems, chronic sequelae of alcohol use were also common, including cirrhosis in around 20% of patients and end-stage liver disease/liver failure in 22% of patients.

Table 3 describes the clinical characteristics of patients with drug abuse-related admissions. Active drug users constituted 67% of patients with drug use disorders. Acute overdose accounted for 72% of the admissions, with respiratory failure

**Table 4.** Additional characteristics of drug and alcohol abuse patients.

Past in-patient psychiatric rehabilitation	21 (14%)
Employed	54 (34%)
Psychiatric comorbidity	36 (23%)
Had ER visits in past 1 year	76 (49%)
Median number ER visits in past year (range)	2 (1-39)
Had hospital admissions in past year	48 (31%)
Median number hospital admissions in past year (range)	2 (1-6)
Had ICU admissions in past year	11 (7%)
Median number ICU admissions in past year (range)	1 (1-2)

present in 57%. The most common drugs of abuse were opioids (31%), cocaine (30%), and cannabinoids (30%). No patients self-reported or tested positive for synthetic cannabinoids, though our institution does not routinely test for these drugs and patients may fall into the unknown category.

Table 4 describes some additional important characteristics of the alcohol and drug abuse sample. Only 34% of patients were employed. A significant proportion (23%) had documented comorbid psychiatric illness and 14% had been previously hospitalized for alcohol abuse, drug abuse, or other psychiatric reasons. Nearly 50% of patients had ER visits in the past 1 year related to alcohol or drug use and 31% had hospital admission, including 7% with ICU admissions in the past year.

## Discussion

In our ICU, 21% of patients were admitted due to either acute or chronic conditions related to alcohol or drug misuse. This number is higher than the published international rates of between 4% and 13%,<sup>5-8</sup> but similar to a recently published rate of 19% in a similar U.S. population.<sup>4</sup> Higher rates may be due to the inclusion of patients with chronic sequelae of drug and alcohol misuse in our sample, as opposed to past studies that have included only acute conditions from misuse. Higher rates may also be due to the multiethnic and low socioeconomic population that our hospital serves.

In general, this study highlights the continued burden of alcohol and drug abuse on the healthcare system. In this 6-month period, alcohol and drug abuse patients accounted for a significant number of medical ICU admissions and accrued charges of over 7 million US dollars. Over 50% of this cohort were either admitted with Medicaid/managed care or obtained emergency Medicaid in hospital. One out of 10 (11%) of these relatively young patients died. News reports over the past year have put a spotlight on the worsening drug epidemic in various parts of the country, highlighting the role of opioid and methamphetamine use and the expanded use of naloxone to treat acute drug overdoses. Our data suggest that the acute and chronic complications of alcohol abuse are a more frequent



cause of ICU admission than those related to drug abuse, at least in our community. Over 80% of those admitted with alcohol-related complications were active drinkers.

Of those admitted to the ICU with alcohol or drug-related problems, a significant percentage had prior contact with our healthcare system in the recent past. In the prior year, at least half of patients had one or more emergency room visits and almost one-third had been admitted to the hospital with alcohol or drug-related problems. These represent opportunities for intervention, such as transfer to a rehabilitation program, intensive counseling, pharmacotherapy, or close out-patient follow-up. Only 8% were transferred for in-patient rehabilitation and all of those had coexisting psychiatric conditions requiring stabilization. Studies have shown high rates of readmissions in patients initially admitted with alcohol withdrawal; readmission has been associated with AMA discharge and comorbid psychotic disorder.<sup>11</sup> High readmission rates have also been reported in patients with cocaine and opioid abuse.<sup>12</sup> At least one study has reported that discharge planning protocols, including medication-assisted treatment, for patients admitted with alcohol dependence may reduce subsequent emergency room visits and 30-day rehospitalization.<sup>13</sup> Addition of pharmacotherapy to psychosocial treatment in patients with alcohol dependence has been shown to improve outcomes.<sup>14</sup> Similarly, in patients admitted with opioid abuse, in-patient initiation of opioid agonist therapy and early discharge planning may reduce rates of AMA discharge and increase the likelihood of transfer to long-term out-patient addiction treatment.<sup>15</sup> In particular, in-patient initiation of buprenorphine paired with out-patient addiction services may lead to higher rates of out-patient addition service utilization than in-patient detoxification alone.<sup>16</sup> Initiation of psychiatric services in the hospital in patients admitted with substance use disorders has been shown to decrease rehospitalization rates.<sup>12</sup> After discharge, utilization of patient navigators, such as in other chronic illnesses, may reduce healthcare costs in patients repeatedly requiring in-hospital detoxification.<sup>17</sup>

The continued toll that alcohol abuse takes on many communities provides evidence for the need for additional support from local government for preventive and treatment services. The prevalence of major depressive and anxiety disorder in patients with substance abuse disorders is well established.<sup>18</sup> Coexisting psychotic disorder has been shown to be an independent predictor of rehospitalization in these patients.<sup>11</sup> Given the rates of comorbid psychiatric illness in this population (nearly 25% in our sample), there may be a need for more intensive specialized approaches in this group of patients.



In conclusion, in a medical ICU of a New York City borough serving an ethnically diverse population, over 20% of admissions were due to acute or chronic complications of alcohol or drug use. These admissions were associated with significant cost and mortality. Acute alcohol use was the primary driver of these admissions. Many of these patients had prior emergency room visits or hospitalizations, presenting potential

opportunities for intervention. Many had coexisting psychiatric comorbidities. Further intervention by the medical community and local government appears to be warranted to try to decrease the burden of alcohol and drug-related illness.

### Author Contribution

All authors contributed to the conception and design of the study and approved the final version of the manuscript. In addition, KLC performed data collection, performed data analysis, interpreted results and wrote the initial and final versions of the manuscript; AS, LCD and TU performed data collection and assisted with preparation of the manuscript; MCP and CT interpreted results and assisted with preparation of the manuscript.

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