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## Understanding Patterns Of High-Cost Health Care Use Across Different Substance User Groups

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### Abstract

Substance use contributes to significant societal burdens, including high-cost health care use. However, these burdens may vary by type of substance and level of involvement. Using the 2009–13 National Surveys on Drug Use and Health, we examined all-cause hospitalizations and estimated costs across substance use profiles for alcohol, marijuana, and other illicit drugs. For each substance, we characterized differences between abstainers, nondiagnostic users (people who used the substance but did not meet diagnostic criteria for substance use disorder), and people with substance use disorders. In a multivariate analysis, we found that the odds of hospitalization were 16 percent lower for nondiagnostic marijuana users and 11 percent lower for nondiagnostic alcohol users, compared to abstainers. Neither alcohol- nor marijuana-specific substance use disorders were associated with hospitalization. In contrast, substance use disorders for other illicit drugs were strongly associated with hospitalization: People with those disorders had 2.2 times higher odds of hospitalization relative to abstainers. A more detailed understanding of health care use in different substance user groups could inform the ongoing expansion of substance use services in the United States.

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Substance use disorders contribute substantially to the US public health burden<sup>1,2</sup> and economic costs.<sup>3,4</sup> One in ten deaths of working-age adults can be attributed to excessive alcohol use,<sup>5</sup> and fatal drug overdoses have risen sharply during the past decade.<sup>6,7</sup> The

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annual economic impact of substance abuse in the United States in the form of crime, productivity losses, and health care costs totals hundreds of billions of dollars.<sup>4,8</sup>

A fundamental shift in how substance use disorder services are financed and structured is currently under way. The Affordable Care Act (ACA) has promoted the use of a chronic care model for managing substance use disorders, designating substance use services as essential benefits and spurring their integration into primary care.<sup>9-11</sup> These changes broaden the target population for substance use services to include not only people who are addicted but also those who display potentially harmful patterns of substance use.<sup>11,12</sup> Similarly, over the past decade the federal government has invested substantial resources in promoting the integration of substance use services into general medical settings through screening, brief intervention, and referral to treatment programs.<sup>12,13</sup> This broadening of the target population has been justified as a public health strategy by the notion that substance users who are not addicted account for the bulk of the aggregate harms from substance use because their numbers are so large.<sup>11</sup>

## Impact Of Substance Use On Health Care Use And Costs

The focus on substance use disorders in the ACA and parallel government efforts to promote the integration of substance use services into medical care is driven largely by the premise that substance use is a key contributor to the national problem of escalating health care costs.<sup>11,12</sup> Indeed, studies show that substance use and substance use disorders are associated with use of high-cost services such as inpatient hospitalizations and emergency department visits.<sup>14-16</sup> Recent research found that mental and behavioral disorders were the most common diagnostic category responsible for hospital readmissions in Medicaid, accounting for nearly 20 percent of them.<sup>17</sup>

Many health problems leading to hospitalization stem from, or are exacerbated by, substance abuse. Proximate medical consequences of substance use include overdose, soft tissue infections, endocarditis, and intoxication-related injury and trauma.<sup>18</sup> Medical problems that can be directly worsened by substance use include liver and kidney disease, respiratory conditions, and diabetes.<sup>18</sup>

Individuals with substance use disorders are also likely to exhibit low adherence to medical advice and treatment regimens.<sup>19,20</sup> Importantly, substance use disorders appear to affect health care costs even after increased disease burden is accounted for.<sup>21</sup>

Previous research has examined hospitalizations clearly tied to drug or alcohol abuse, such as those for overdoses.<sup>22,23</sup> However, substance use disorders often go undiagnosed during hospitalization.<sup>24</sup> And besides being the proximate cause of hospitalization in some cases, substance use can have myriad hidden “radiating effects” that could magnify its health and social burdens.<sup>25</sup>

## Focus Of The Present Research

Underlying many recent efforts to expand substance use services in medical settings is the plausible argument that doing so will lead to improved health and cost savings. However,

there are potentially important distinctions across substances and types of users. In the current study we characterized differences in hospitalization and costs for abstainers; nondiagnostic users (those who used the substance in the past year but did not meet substance use disorder diagnostic criteria); and people who did meet those criteria for alcohol, marijuana, and other drugs.

## Study Data And Methods

### DATA SOURCE

This study used five years of data from the National Survey on Drug Use and Health, the authoritative source of information on the prevalence of substance use and substance use disorders in the United States.<sup>26</sup> This annual survey, conducted by the Substance Abuse and Mental Health Services Administration, is representative of the US noninstitutionalized civilian population ages twelve and older. It includes individuals residing in households or noninstitutional group quarters (such as college dormitories or homeless shelters) in all fifty states and the District of Columbia.

To improve the stability of estimates for lower-prevalence phenomena, we pooled annual surveys for the period 2009–13. There were 281,411 respondents, or approximately 55,000 each year. The data reported in this article represent five-year annual average estimates for the US population and subgroups.

### VARIABLES

- ▶ **HOSPITALIZATION:** Past-year all-cause hospitalization was determined by this survey question: “During the past 12 months, have you stayed overnight or longer as an inpatient in a hospital?”
- ▶ **CUMULATIVE LENGTH-OF-STAY:** The survey also asked about the total number of nights of hospitalization, with responses top-coded at thirty-one or more nights (that is, all responses of greater than thirty nights were coded as thirty-one nights). These counts were used for generating estimates of cumulative length-of-stay and costs (described below) that were conservative (because of top-coding).
- ▶ **COSTS:** Cost estimates per hospital inpatient day were obtained from the Henry J. Kaiser Family Foundation’s State Health Facts initiative.<sup>27</sup> The source for these estimates is the American Hospital Association, and the data include information on operating and nonoperating expenses for US community hospitals.

We obtained the average annual cost of an inpatient hospital day for each year. We then adjusted values to 2013 dollars and computed costs incurred for each survey respondent (cumulative nights of hospitalization multiplied by cost per inpatient day for that year).

- ▶ **SUBSTANCE USE PROFILES:** We used survey questions to create substance use profiles for alcohol, marijuana, and all other illicit drugs (besides marijuana) combined. As described below, the category of other illicit drugs includes street drugs as well as prescription drugs such as pharmaceutical opioids, stimulants, and

sedatives or tranquilizers when used for nonmedical purposes. For each profile, we divided respondents into three categories based on their behavior in the past year (the same time frame as we used for hospitalizations): abstainers (people who did not use the substance in the past year), nondiagnostic users (people who used the substance in the past year but did not meet substance use disorder diagnostic criteria), and people who did meet those criteria. *Substance use disorder* was defined as meeting the diagnostic criteria for substance abuse or dependence from the *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition (DSM-IV).

Categories were mutually exclusive within each substance. However, they could overlap across substances if, for example, a person had disorders for multiple substances.

Additional profiles were generated for major drugs of abuse such as heroin, opioid analgesics, cocaine, amphetamines or related stimulants, and sedatives or tranquilizers. Profiles for prescription drug misuse were limited to nonmedical use—that is, using a medication that was not prescribed or using a prescribed medication “only for the experience or feeling it caused.”<sup>26</sup>

## RESPONDENT CHARACTERISTICS

Background characteristics used as control variables in statistical models were age; sex; race/ethnicity (white, black, Hispanic, or other); employment status (full time; part time; unemployed; or other, including not in the labor force); poverty status (income below the federal poverty level, at 100–199 percent of poverty, or at 200 percent or more of poverty); whether the respondent had health insurance, smoked cigarettes, and had a diagnosis of depression in the past year; and self-reported overall health status (excellent, very good, good, or fair/poor). Our method of selecting control or confounder variables was to include basic population characteristics commonly used in epidemiological studies, as well as basic factors that could plausibly vary in terms of substance use patterns, health, health care use, or some combination of the three.

## STATISTICAL ANALYSIS

We conducted analyses using Stata SE, version 13, and the command suite for complex survey data. We applied appropriate adjustments for survey design characteristics (population weight, primary sampling unit, and stratification layer). Sampling weights were adjusted to produce five-year annual average estimates.

To provide a descriptive snapshot of the US population, we first examined unadjusted prevalence of hospitalization by substance use profile. We also examined cumulative length-of-stay and aggregate and per person hospital costs incurred for each substance use profile.

We then fit a multivariate logistic regression model of hospitalization in the past year. The model included the three main substance use profiles (alcohol, marijuana, and other illicit drugs) as separate categorical predictors. The model additionally adjusted for survey year and respondent demographic characteristics (sex, race/ethnicity, and age), economic

characteristics (poverty and employment status), and health variables (depression, cigarette use, insurance status, and self-reported health status).

We extended this approach to explore sex and age differences in detail, fitting a series of sex-specific subpopulation models in which the relationship between substance use profile and hospitalization was allowed to vary by age cohort (that is, profile by age cohort interactions). We did this because interpreting differences between substance use profile categories was complicated by the fact that hospitalization risk differs by age, doing so differently for males and females.

## LIMITATIONS

This study had several limitations. First, while the study offered a comprehensive epidemiological snapshot of the US population, our analyses should be considered descriptive, with the multivariate modeling representing conditional associations and a high-elevation approximation of the phenomenon. We avoided making assumptions about causality given the cross-sectional nature of the data. Speculation about causation must be made with caution and attention to the caveats of the design.

Second, our analysis was limited by the questions asked in the survey. For example, we could not separately examine hospitalizations due to pregnancy. Childbirth is the most common reason for hospitalization in the United States<sup>28</sup> and likely contributes to the observed spike in hospitalization during the childbearing years for abstaining women.

Third, the data were self-reported and subject to the limitations of such reporting. However, as the largest survey focused on substance use in the United States, the National Survey on Drug Use and Health employs extensive procedures to ensure data quality and maximize accuracy.<sup>26</sup>

Our study also had strengths. Chief among these was its use of large nationally representative surveys spanning five years of data collection. The robust sample size is important given that hospitalization is a relatively rare event. In addition, the data source provided rich information on substance use behaviors, including an assessment of detailed diagnostic criteria for various substances.

## Study Results

### PREVALENCE OF HOSPITALIZATION BY SUBSTANCE USE PROFILE

The average annual rate of hospitalization in 2009–13 was 10.2 percent. The prevalence of hospitalization among alcohol abstainers (12.5 percent) was significantly higher than for nondiagnostic drinkers (8.9 percent) or people with alcohol use disorder (10.0 percent) (Exhibit 1). The prevalence of hospitalization among marijuana abstainers did not differ significantly from that among people with marijuana use disorder, but the prevalence was significantly lower for nondiagnostic marijuana users than for abstainers. For illicit drugs other than marijuana, rates of hospitalization differed significantly between all use profiles. When we examined other illicit drugs in detail, we found that people with substance use

disorders had much higher rates of hospitalization than abstainers or nondiagnostic users in every drug category.

### **CUMULATIVE LENGTH-OF-STAY**

We examined cumulative length of hospital stay (total nights of hospitalization across all hospitalization episodes) descriptively (online Appendix Exhibits 1 and 2).<sup>29</sup> Nondiagnostic alcohol users had the lowest average cumulative length-of-stay (4.35 nights), while people with substance use disorders for illicit drugs other than marijuana had the highest average cumulative length-of-stay (6.99 nights).

### **COST ESTIMATES**

Estimated annual per person hospital costs were \$1,122 for the 17.6 million people with alcohol use disorders, \$1,057 for the 4.2 million people with marijuana use disorders, and \$2,783 for the 3.5 million people with substance use disorders involving other illicit drugs (Exhibit 2).

### **MULTIVARIATE MODEL OF HOSPITALIZATION IN THE PAST YEAR**

We used a multivariate logistic regression model to provide information on conditional associations, adjusting for potentially important confounding factors and population differences. The model shows a good fit with the data ( $F(9,52) = 0.66$ ;  $p = 0.74$ ).

Nondiagnostic drinkers had 11 percent lower odds of hospitalization than abstainers (Exhibit 3). Having an alcohol use disorder was not associated with hospitalization, compared to abstaining. Nondiagnostic marijuana use was associated with 16 percent lower odds of hospitalization, compared to abstaining. The likelihood of hospitalization among people with marijuana use disorder did not significantly differ from that of either abstainers or nondiagnostic users.

For illicit drugs other than marijuana, the odds of hospitalization among people with substance use disorders were 2.2 times higher compared to abstainers. Nondiagnostic users of these drugs did not differ significantly from abstainers in their likelihood of hospitalization.

### **SEX AND AGE COHORT DIFFERENCES**

Sex-specific subpopulation models that allowed us to identify unique profile differences by age cohort revealed some instructive nuances (Appendix Exhibit 3).<sup>29</sup> For alcohol, female abstainers and nondiagnostic drinkers ages 18–34 experienced heightened probabilities of hospitalization—a spike that may reflect hospitalization for pregnancy and delivery in the childbearing years. Hence, for females, abstainers represent a shifting baseline for comparison. This has consequences for interpretation, particularly for alcohol and marijuana use, for which differences between profile categories can be considered subtle.

Importantly, the probability of hospitalization was considerably elevated for people with substance use disorders involving illicit drugs other than marijuana. This is a strong pattern that held for both sexes across all age cohorts.

## Discussion

This article reports five-year annual average estimates of all-cause hospitalizations in the US population, examining differences among abstainers, nondiagnostic users, and people with substance use disorders involving various substances. Our study found a clear and unambiguous relationship between hospitalization and substance use disorders involving illicit drugs other than marijuana. For these substances, hospitalization rates are much higher for people meeting substance use disorder criteria than for nondiagnostic users and abstainers. More than one in four people with a substance use disorder involving heroin can be expected to experience an inpatient hospital stay in the course of a year. Similarly, we found high rates of hospitalization among people with substance use disorders specific to opioid analgesic misuse—a serious public health problem that has contributed to escalating overdose deaths in many communities.<sup>6,7</sup>

Previous studies have documented the link between substance use diagnoses and hospitalization or readmission in Medicaid<sup>14,15,17</sup> and in smaller samples,<sup>30</sup> and the link between those diagnoses and admissions nationally known to be directly related to drug use.<sup>22,23</sup> Our study extends the literature by examining hospitalizations across relatively nuanced substance use profiles in a large nationally representative sample. A unique aspect of the study is that substance use and detailed substance use disorder criteria were independently assessed for each survey respondent and thus did not rely on clinical detection or diagnosis during hospitalization, which is likely to undercount cases of nondiagnostic substance use and substance use disorders.

## Policy Implications

At the population level, hospitalization is an important indicator of serious public health burden and high-cost use of health care. A key objective of health care reform is to reduce avoidable high-cost use of health care, and early data suggest that reform has had some success in this area.<sup>31</sup> It is anticipated that individuals newly insured under the ACA will have higher rates of substance use disorders, compared to existing Medicaid beneficiaries.<sup>32</sup> Using a nationally representative survey with more than a quarter-million respondents, the current study provides a baseline from which to track hospitalization among different types of substance users in the era after health care reform.

The United States is in the midst of a major realignment of substance use and behavioral health services, which reflects a broadening of the target population and delivery venues for substance use services in an effort to improve public health and reduce system cost burdens. Hospitalization is just one of many indicators. However, our study documents important differences based on substance type and level of use.

Nondiagnostic substance users do not appear to be major drivers of public health burden or costs related to hospitalizations. Thus, the approach of targeting interventions toward a broader base of lower-risk drug users may be unlikely to prompt population-level reductions in such burdens in the short term. However, that approach could have longer-term impacts if these services are able to prevent progression toward severe substance use disorders.<sup>11</sup>



Our findings also have implications for shaping the expansions of behavioral health and substance use services. For example, our results could help determine which substance user groups to target with interventions. Given the base-rate differences across substance use profiles, targeting services toward different substance user groups offers varying degrees of opportunity to affect hospitalizations.

Neither alcohol nor marijuana use disorders were associated with hospitalization, but there was a strong association between hospitalization and other drug use disorders. Similarly, costs incurred by people with substance use disorders involving illicit drugs other than marijuana exceeded costs for people with marijuana use disorders on both an aggregate and a per person basis—which reflects the higher likelihood of hospitalization and longer cumulative length-of-stay for people in the first group. Targeting people with other illicit drug substance use disorders could offer significant opportunities for reducing hospitalizations and perhaps broader public health burdens.

Previous research has shown that hospital patients diagnosed with a drug substance use disorder are more likely to experience recurrent acute hospital utilization, compared to patients discharged without such diagnosis.<sup>30</sup> Our findings support the idea of using hospitals as possible venues in which to identify and intervene with higher-risk populations of drug users (such as people with substance use disorders involving illicit drugs other than marijuana). Such interventions could have an important impact if they linked patients with substance use disorders to effective addiction treatment and ongoing medical care, which could reduce future hospitalizations.<sup>33</sup> Hence, future research should identify effective strategies for expanding substance use disorder services in hospitals and facilitating the linking of patients to treatment after discharge.

Our findings with respect to marijuana are of particular interest, given the rapidly evolving nature of marijuana policy in many states. Marijuana use can have a range of adverse health consequences.<sup>34</sup> However, this study did not find elevated rates of hospitalization among people with marijuana use disorders. Moreover, non-diagnostic marijuana users tended to have a lower likelihood of hospitalization than abstainers, and this relationship held even after adjustment for potential confounding factors and population differences.

This result could suggest that marijuana use has genuine protective effects, or it could ultimately be explained by other factors. The lack of a significant contemporaneous association between hospitalizations and marijuana use disorders implies that concerns that liberalization of marijuana policy will strain hospital resources may be unfounded, at least in the immediate term. For instance, sizable public health and societal burdens from increased marijuana use might not immediately become manifest.

## Conclusion

We examined nationally representative data on all-cause hospitalizations for different substance user groups. We examined hospitalization rates across substance use profile subpopulations and their independent associations in multivariate models. Relative to abstainers, the likelihood of experiencing hospitalization is lower for those who use



marijuana or alcohol at nondiagnostic levels. While significant, these relationships are relatively subtle. In contrast, people with substance use disorders involving illicit drugs other than marijuana have substantially elevated rates of hospitalization. Understanding patterns of high-cost health care use across different substance use profiles can inform the continued integration of behavioral health and medical services in the US health care system.

## Acknowledgments

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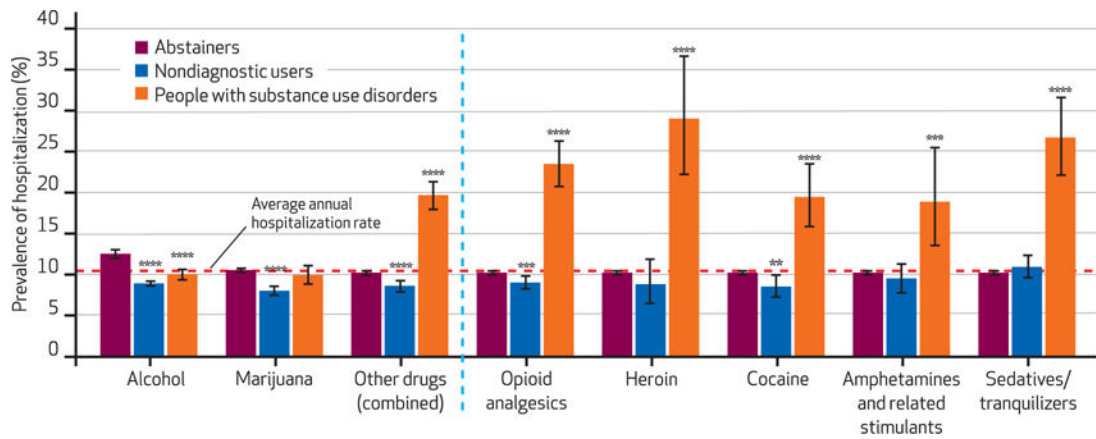
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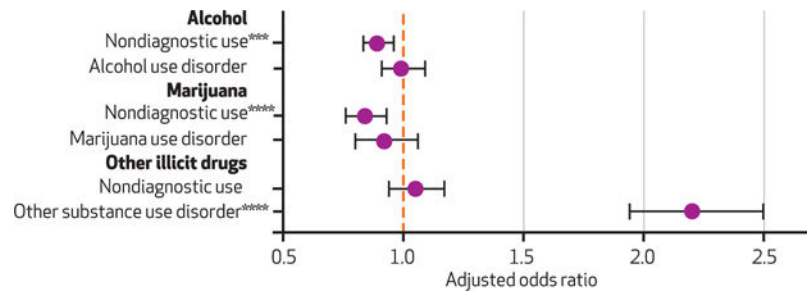
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**EXHIBIT 1. Average Annual Prevalence Of Hospitalization Among Abstainers, Nondiagnostic Users, And People With Substance Use Disorders, 2009–13**

**SOURCE** Authors' analysis of data for 2009–13 from the National Survey on Drug Use and Health. **NOTES** There were 281,411 respondents to the 2009–13 surveys. The prevalence values are weighted univariate population prevalence estimates. The average annual hospitalization rate for 2009–13 was 10.2 percent (denoted by the red dotted line). Whiskers represent 95% confidence intervals. "Other drugs" includes, among others, the drugs shown to the right of the blue dotted line. Significance denotes differences between abstainers and nondiagnostic users and between abstainers and people with substance use disorders. \*\* $p < 0.05$  \*\*\* $p < 0.01$  \*\*\*\* $p < 0.001$



**EXHIBIT 3. Relative Odds Of Hospitalization, By Substance Use Profile**

**SOURCE** Authors' analysis of data for 2009–13 from the National Survey on Drug Use and Health. **NOTES** Of the 281,411 respondents to the 2009–13 surveys, 9,392 had missing data on control variables, leaving 272,019 for this analysis. Adjusted odds ratios with 95% confidence intervals (the whiskers) are relative to abstinence in each category (the orange dotted line). \*\*\* $p < 0.01$  \*\*\*\* $p < 0.001$

**EXHIBIT 2**

Average Annual Estimates Of Aggregate And Per Person Hospital Costs Among Abstainers And People With Substance Use Disorders, 2009–13

Substance use profile	Aggregate (billions)		Per person	
	Cost	95% CI	Cost	95% CI
<b>ALCOHOL</b>				
Abstainers	\$112.9	(\$104.5, \$121.3)	\$1,318	(\$1,228, \$1,408)
Alcohol substance use disorder	19.8	(\$17.2, \$22.4)	1,122	(\$972, \$1,271)
<b>MARIJUANA</b>				
Abstainers	228.0	(\$218.0, \$238.0)	1,010	(\$968, \$1,052)
Marijuana substance use disorder	4.5	(\$3.5, \$5.5)	1,057	(\$829, \$1,285)
<b>OTHER ILLICIT DRUGS</b>				
Abstainers	230.6	(\$220.5, \$240.8)	978	(\$937, \$1,019)
Alcohol substance use disorder	9.7	(\$7.9, \$11.5)	2,783	(\$2,291, \$3,275)

**SOURCE** Authors' analysis of data from the following sources: (1) Data for 2009–13 from the National Survey on Drug Use and Health. (2) Henry J. Kaiser Family Foundation. Hospital adjusted expenses per inpatient day (Note 27 in text). **NOTE** CI is confidence interval.

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