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## Service involvement across multiple sectors among people who use opioids, methamphetamine, or both, United States - 2015-2018

Benjamin A. Howell, MD, MPH, MHS<sup>1,2</sup>, Gavin Bart, MD, PhD<sup>3,4</sup>, Emily A. Wang, MD, MAS<sup>1,5</sup>, Tyler N.A. Winkelman, MD, MSc<sup>4,6</sup>

<sup>1</sup>National Clinician Scholars Program, Yale School of Medicine, New Haven, CT

<sup>2</sup>VA Connecticut Healthcare System, West Haven, CT

<sup>3</sup>Division of Addiction Medicine, Department of Medicine, Hennepin Healthcare, Minneapolis, MN

<sup>4</sup>Hennepin Healthcare Research Institute, Minneapolis, MN

<sup>5</sup>Division of General Internal Medicine, Yale School of Medicine, New Haven, CT

<sup>6</sup>Division of General Internal Medicine, Department of Medicine, Hennepin Healthcare, Minneapolis, MN

### Abstract

**Background:** The fourth wave of the opioid crisis is characterized by increased use and co-use of methamphetamine. How opioid and methamphetamine co-use is associated with health care use, housing instability, social service use, and criminal justice involvement has not been studied and could inform future interventions and partnerships.

**Objectives:** To estimate service involvement across sectors among people who reported past year opioid and methamphetamine co-use, methamphetamine use, opioid use, or neither opioid nor methamphetamine use.

**Research Design:** We examined 2015–2018 data from the National Survey on Drug Use and Health. We used multivariable negative binomial and logistic regression models and predictive margins, adjusted for sociodemographic and clinical characteristics.

**Subjects:** Non-elderly US adults aged 18 or older.

**Measures:** Hospital days, emergency department visits, housing instability, social service use, and criminal justice involvement in the past year.

**Results:** In adjusted analyses, adults who reported opioid and methamphetamine co-use had 99% more overnight hospital days, 46% more emergency department visits, 2.1 times more housing

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Corresponding author: Benjamin A. Howell, MD, MPH, MHS, PO Box 208088, New Haven, CT 06520, benjamin.howell@yale.edu. Additional Author Information: Gavin Bart, MD, PhD, Hennepin County Medical Center, 701 Park Ave, Minneapolis, MN 55105; Emily A. Wang, MD, MA, PO Box 208056, New Haven, CT 06520; Tyler N.A. Winkelman, MD, MSc, Hennepin County Medical Center, 701 Park Ave, S2.309, Minneapolis, MN 55105

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instability, 1.4 times more social service use, and 3.3 times more criminal justice involvement compared to people with opioid use only. People who used any methamphetamine, with opioids or alone, were significantly more likely to be involved with services in 2 or more sectors compared with those who used opioids only (Opioids only: 11.6%; methamphetamine only: 19.8%; opioids and methamphetamine: 27.6%).

**Conclusions:** Multi-sector service involvement is highest among those who use both opioids and methamphetamine, suggesting that partnerships between health care, housing, social service, and criminal justice agencies are needed to develop, test, and implement interventions to reduce methamphetamine-related morbidity.

### Keywords

methamphetamine use; opioid use; polysubstance use; cross-sector service use; criminal justice involvement

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### Background:

Opioid overdose deaths in the United States (US) remain at unprecedented levels and represent an ongoing public health crisis. Deaths related to methamphetamine and other psychostimulants have increased over six-fold during the last decade, further complicating the crisis.(1) Co-occurring opioid and methamphetamine use, and methamphetamine only, now represent the fourth wave of the overdose crisis.(2, 3) Co-use of opioids and methamphetamine in the US increased 86% among those seeking treatment for opioid use disorder (4–6) and hospitalizations involving both opioids and methamphetamine increased over 500% between 2003 and 2015.(7) Methamphetamine use alone is associated with significant morbidity, including increased psychiatric morbidity,(8–10) high-risk sexual behavior,(11, 12) HIV infection,(13–15) and heart disease,(9, 13) which further complicates opioid use and its health consequences.

To address the opioid overdose epidemic, there have been efforts to understand how interactions with health care and non-health care sectors influence overdose risk.(16) Cross-sector analysis examines how patients intersect with health care, housing, social service, and criminal justice systems to identify novel opportunities to engage people in treatment and develop collaborations across normally siloed sectors.(17–20) It is unknown whether service involvement across sectors among adults who use both opioids and methamphetamine, or methamphetamine only, differ from people who report opioid use only.(21, 22) While effective treatments for methamphetamine use are limited, cross-sector data could identify partnerships to develop novel programs and/or reduce methamphetamine-associated harms. (23)

Our objective was to use nationally representative data to describe hospital and emergency department use, housing instability, social service use, and criminal justice involvement among people who co-use opioids and methamphetamine or use methamphetamine only compared to the general population and to people who use opioids only. We hypothesized that methamphetamine use would be associated with higher utilization of services across

multiple sectors compared with opioid use and that people who co-use methamphetamine and opioids would have the highest rates of service use.

## Methods:

We used 2015–2018 data from the National Survey on Drug Use and Health (NSDUH), an annual survey of the non-institutionalized US population designed to estimate the prevalence of substance use and mental illness. The NSDUH uses a complex survey design in all 50 states and includes approximately 55,000 residents age 12 and older in each annual, de-identified public use data set.(24) We limited our analyses to respondents age 18 or older.

### Independent variable: past year substance use

Our exposures of interest were any reported illicit opioid use in the past year but no methamphetamine use, methamphetamine use in the past year but no illicit opioid use, use of both illicit opioids and methamphetamine in the past year, or neither opioid nor methamphetamine use in the past year (herein no opioid/methamphetamine use). Illicit opioid use (herein opioid use) was defined as heroin use or any use of prescription opioids that were not taken as directed by a doctor in the past year.

### Dependent variables: cross-sector service involvement

Our main outcomes were involvement in services in four domains and in multiple of these domains in the past year: acute health care use (i.e., number hospital days, number of emergency department visit), housing instability, social service use, and criminal justice involvement. For acute health care use, we created count variables of number of hospital days and emergency room visits in the past year. In line with other cross-sector service analysis(25–27), we included a variable for housing sector use, but were limited by NSDUH data. As a proxy for housing sector use, we dichotomized responses on housing instability similar to specifications used in previous work: moved zero or one time in the past year vs. moved two or more times in the past year.(28, 29) We identified respondents as using social services if they reported receiving social security income, food stamps, cash assistance, or non-cash assistance (e.g., childcare) through a government program in the past year. We identified a respondent as having criminal justice involvement in the past year if they reported an arrest in the past year or having been on probation or parole in the past year.

We created a multi-sector involvement variable that totaled the number of sectors in which an individual reported past year involvement: (zero sectors, one sector, or two or more sectors.)

### Covariates

We included the following covariates in our adjusted analyses: age, race/ethnicity, gender, poverty, rurality, serious psychological distress, and self-reported health. These covariates were included to address potential confounding by demographic and clinical factors previously associated with higher service utilization.(23, 30, 31) For our analyses, we collapsed rural-urban continuum codes (RUCC) developed by the US Department of Agriculture into two categories: urban (RUCC 1–3) and rural (RUCC 4–9).(32) We coded

presence of serious psychological distress using a score of greater than or equal to 13 on the Kessler Psychological Distress Scale (K6), a validated screening tool for detecting serious mental illness in the general population. (33)

### Statistical Analysis

We first estimated and compared weighted proportion of demographic and clinical characteristics for adults who reported no opioid/methamphetamine use, opioid use only, methamphetamine use only, or opioid and methamphetamine use. We then described demographic and clinical factors of people who reported service involvement in individual sectors and service involvement in 2 or more sectors.

Next, we estimated weighted frequencies of inpatient hospital days, emergency department visits, housing instability, social service use, and criminal justice involvement and use of 0, 1, or 2 or more sectors in the past year. We then estimated multivariable regression models for each outcome and computed predictive margins to obtain adjusted probabilities of service involvement across multiple sectors for each substance use category.(34) For hospital days and emergency department visits, we used negative binomial regression and reported adjusted probabilities of events per 100 person-years. For housing instability, social service use, and criminal justice involvement, we used logistic regression models and presented probabilities as a percentage within each population. Finally, we used a multivariable logistic regression model to estimate associations between sociodemographic and clinical characteristics and involvement in services in 2 or more sectors compared to use of 0–1 sectors in the past year.

All analyses used person-level survey weights provided by NSDUH to generate estimates representative of the non-institutionalized US population. We used Stata's *svy* command to account for primary sampling unit and strata variables, in addition to the person-level weights reported in the public use data file. All analyses were performed using Stata/SE version 15.1 (*StataCorp*, College Station, TX). Two-sided *P* values <.05 were considered statistically significant *a priori*. This study was considered exempt by the Yale University Human Investigations Committee.

### Results:

Our study sample consisted of 171,766 adult respondents. The annualized proportion who reported opioid use only was 4.0% (95% Confidence Interval (CI):3.9%–4.2%; weighted N: 9,943,000), methamphetamine use only was 0.4% (95% CI:0.3%–0.4%; weighted N: 889,301), and both opioid and methamphetamine use was 0.3% (95% CI:0.2%–0.3%; weighted N: 738,856). Sociodemographic and clinical characteristics across the four substance use categories are reported in Table 1. Compared to people who reported opioid use only, those who reported methamphetamine use only, or both opioid and methamphetamine use were more likely to be American Indian/Alaskan Native, male, live in a rural county, live below 100% federal poverty line, report fair or poor health, and report serious psychological distress.

### Service Involvement in Individual Sectors

In unadjusted analyses, adults who reported any methamphetamine use, with or without opioid use, had significantly more hospital days ( $P .01$ ,  $P=0.04$ ) and more emergency department visits ( $P .001$  for both) than people with opioid use only. In addition, adults with any methamphetamine use, with or without opioid use, were more likely to report housing instability ( $P .001$  for both), social service use ( $P .001$  for both), and criminal justice involvement ( $P .001$  for both) in the past year than people with opioid use only (Figure 1; Table 2). Sociodemographic characteristics of each single sector category are included in the Table, Supplemental Digital Content 1.

After adjusting for demographic and clinical factors, people with both methamphetamine and opioid use had nearly twice as many hospital days ( $P .01$ ) and 46% more emergency department visits ( $P .001$ ) compared with people with opioid use only (Table 2). In the adjusted analysis the proportion of adults with both opioid and methamphetamine use reported housing instability was 2.2 times higher ( $P .001$ ), social service use was 1.3 times higher ( $P .001$ ), and criminal justice involvement was 3.3 times higher ( $P .001$ ) than people with opioid use only Table 2.

### Multi-Sector Service Involvement

In unadjusted analyses, 6.4% of individuals with no opioid/methamphetamine use, 15.9% with opioid use only, 33.9% with methamphetamine use only, and 49.4% with both opioid and methamphetamine use reported involvement in 2 or more sectors in the past year (Figure 2; Table 3). After adjustment, the proportions of people with methamphetamine use only ( $P .001$ ) or both opioid and methamphetamine use ( $P .001$ ) who were involved with services from 2 or more sectors were 71% and 138% higher, respectively, compared with those with opioid use only (Table 3). Individuals reporting service involvement across 2 or more sectors, across all drug use categories, had higher proportions living below 200% the federal poverty level, in fair or poor health, and with serious psychological distress (Table, Supplemental Digital Content 2) compared with overall study population characteristics in Table 1.

People who reported involvement in 2 or more sectors were significantly more likely to live below 200% (adjusted odds ratio (aOR) 4.34, 95% CI 3.92–4.57) or 100% of the federal poverty level (aOR 9.58, 95% CI: 8.89–10.31) compared to those who lived at >200% the federal poverty level (Table, Supplemental Digital Content 3). They were also more likely to report serious psychological distress (aOR 2.03, 95% CI 1.90–2.17) or have self-reported fair or poor health (aOR 2.77, 95% CI: 2.58–2.97).

### Discussion:

In this national sample of US adults, we found that people who reported co-use of opioids and methamphetamine or use of methamphetamine only in the past year were significantly more likely to report higher levels of involvement in health care, housing, and social service sectors and more involvement with the criminal justice system compared with people who reported opioid use only or no opioid/methamphetamine use in the past year. In an era of

rising methamphetamine use, with and without opioids, aggregated societal costs related to methamphetamine use are likely to be large.(35) A coordinated response across sectors is needed to decrease the burden of methamphetamine use and co-use on individuals, families, and communities and especially address health-related harms.

Our results add to the existing literature of characteristics among people who frequently use acute health care services. While substance use in general is associated with high use of acute health care,(23, 36, 37) the literature on health care use associated with methamphetamine use is limited. Our results demonstrate that people who use methamphetamine have higher rates of acute health care use than people who use opioids. Although our data cannot identify the causes of hospitalization, possible causes are cardiovascular toxicity(9, 13, 21) or psychiatric symptoms, such as acute psychosis and mood disorders,(13, 38) associated with methamphetamine use. Finally, people who use methamphetamine may preferentially access health care in acute settings, as beliefs and attitudes among health professionals about people who use methamphetamine can create barriers to non-acute health care for this population.(39)

In line with other work on cross-sector service analysis, our results reinforce that people who frequently use health care services also frequently are involved in services in other sectors.(23) Along with high acute health care use, we found higher rates of housing instability and social service use. The associations between involvement, substance use, and our covariates are complex, and the directionality of relationships cannot be elucidated in this cross-sectional study. Qualitative work has found that people experiencing homelessness report methamphetamine use to increase safety in tenuous living conditions,(27, 40) whereas methamphetamine use itself may also lead to financial instability and subsequent homelessness. We also found that poverty, self-reported fair or poor health, and serious psychological distress were independently associated with increased cross-sector involvement. Further research should focus on elucidating the causal mechanisms of cross-sector use.

Our findings build on reports of increased jail and prison admissions related to methamphetamine,(41) and single-site studies that have reported high rates of housing instability among people who use methamphetamine.(42, 43) The high prevalence of housing instability and criminal justice involvement likely reinforces the cycle of high acute care use.(26, 44, 45) Thus, reducing methamphetamine use only, without attention to other social determinants, may not reduce acute care use once someone has entered a cycle of homelessness and incarceration.

Collaborations that account for the cross-sector usage patterns may be a more effective approach than siloed sector specific interventions. Of note, cross-sector interventions are already being piloted to address morbidity and mortality associated with opioid use disorder.(46) Our work highlights that similar cross-sector work may also have a role in addressing the fourth wave of the opioid crisis; although the limited number of evidence-based interventions for methamphetamine use may limit their efficacy.(3)

## Limitations

Our results should be interpreted in the context of some limitations. All outcomes were measured by self-report and cannot be verified through claims or administrative data, though self-reported data on criminal justice involvement has been shown to be a valid measure in previous studies.(47) Our measure of housing instability was chosen as a proxy for housing service use and should be interpreted with this limitation in mind. Also, while there are some concerns that substance use reported in the NSDUH may be somewhat underreported, this would bias our results towards the null.(48) The NSDUH does not include data on the indication for hospitalization or emergency department visits, and therefore, we are unable to determine if those visits were associated with methamphetamine use. Finally, by design, the NSDUH does not survey adults who are institutionalized or unhoused. Given the likely higher prevalence of methamphetamine use among people who are homeless or incarcerated, these data are likely a conservative estimate of overall methamphetamine use in the past year.

## Conclusion

Hospital days, emergency department visits, housing instability, social service use, and criminal justice involvement were significantly higher among US adults who reported past year use of both opioids and methamphetamine or use of methamphetamine only compared with people who reported opioid use only or neither opioid nor methamphetamine use. Cross-sector involvement was highest among individuals with both opioid and methamphetamine use, which suggests that the fourth wave of the opioid crisis may result in greater societal costs than earlier waves of the crisis. Cross-sector collaborations and investments in methamphetamine use prevention and treatment research are needed to improve public health and blunt the increasing complexity of the opioid crisis.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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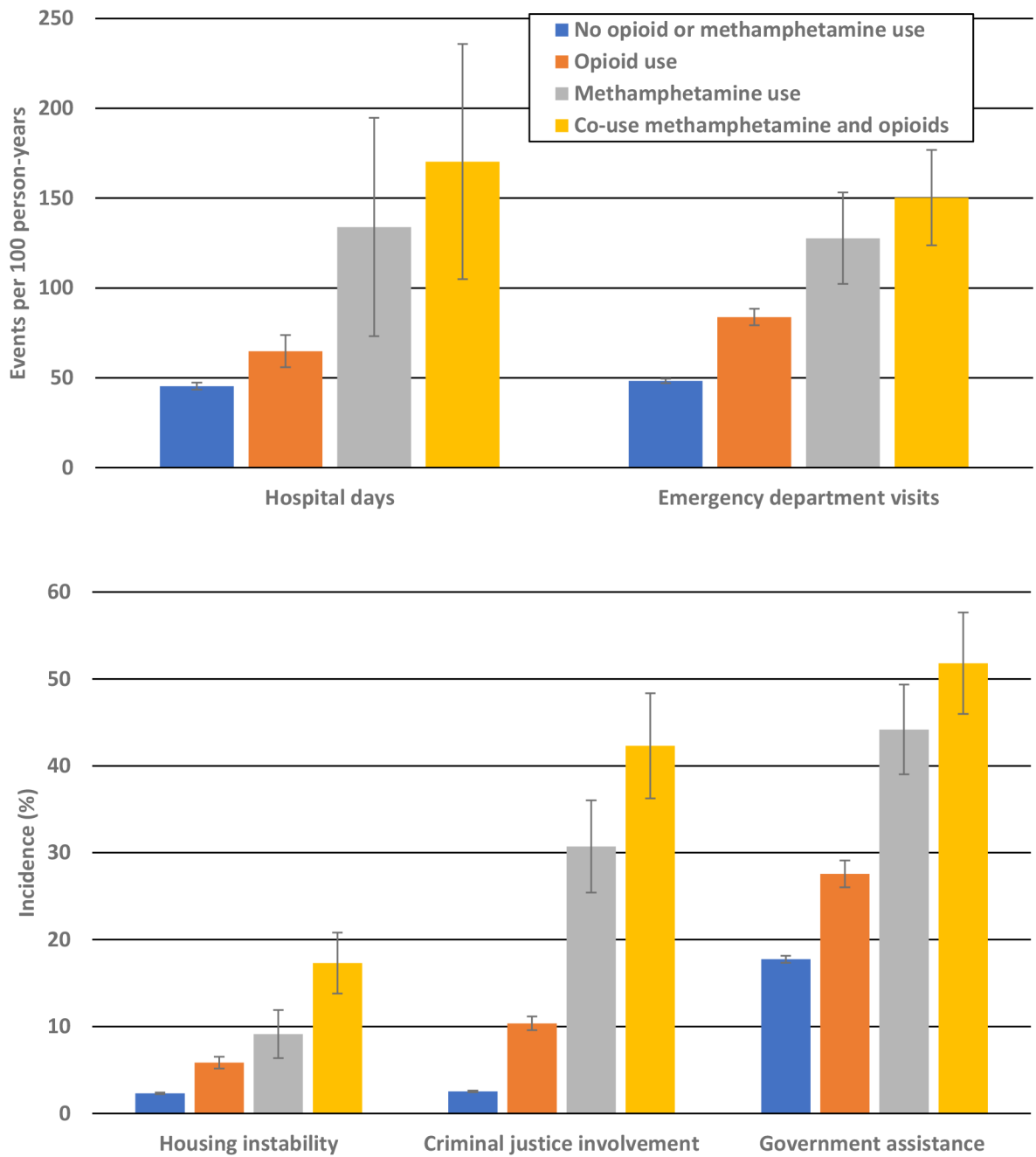
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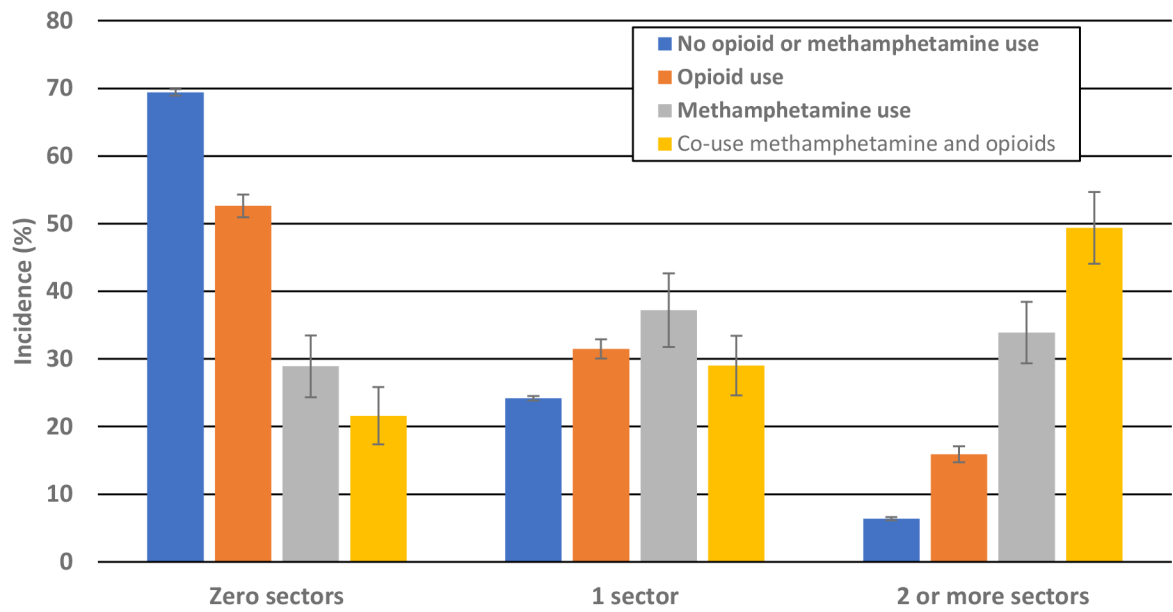


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**Figure 1.** Unadjusted service use among people who reported use of opioids, methamphetamine, or both opioids and methamphetamine compared to people who reported no use, 2015–2018  
 Notes: Estimates reflect weighted proportions based on survey methodology. Error bars reflect 95% confidence interval.



**Figure 2.** Unadjusted multi-sector service use among people who reported use of opioids, methamphetamine, or both opioids and methamphetamine compared to people who reported no use, 2015–2018

Notes: Estimates reflect weighted proportions based on survey methodology. Error bars reflect 95% confidence interval.

**Table 1.**

Sociodemographic and clinical characteristics of study population by reported substance use in the past year, United States, 2015–2018

	No Illicit Opioid or Methamphetamine Use in Past Year (N=161,558)	Illicit Opioid Use in Past Year (N=8,721)	Methamphetamine Use in Past Year (N=762)	Methamphetamine and Illicit Opioid Use in Past Year (N=725)
<b>% of total population</b>	95.3% (95.2%–95.4%)	4.0% (3.9%–4.2%)	0.4% (0.3%–0.4%)	0.3% (0.2%–0.3%)
<b>Female</b>	52.1% (51.7%–52.5%)	45.9% (44.4%–47.3%)	38.4% (33.9%–43.0%)	34.9% (30.4%–39.7%)
<b>Age Range, y</b>				
<b>18–25</b>	13.6% (13.3%–13.8%)	23.2% (22.1%–24.3%)	16.5% (13.7%–19.8%)	23.5% (20.0%–27.4%)
<b>26–34</b>	15.5% (15.2%–15.8%)	24.8% (23.6%–26.0%)	24.3% (20.8%–28.1%)	29.3% (25.2%–33.7%)
<b>35–49</b>	24.7% (24.3%–25.0%)	25.5% (24.4%–26.7%)	31.8% (28.1%–35.7%)	30.6% (26.2%–35.3%)
<b>50+</b>	46.3% (45.7%–46.8%)	26.5% (24.8%–28.3%)	27.5% (23.1%–32.3%)	16.7% (12.0%–22.8%)
<b>Race/Ethnicity</b>				
<b>White, non-Hispanic</b>	63.9% (63.3%–64.4%)	67.0% (65.3%–68.7%)	68.5% (63.8%–72.9%)	77.5% (73.0%–81.4%)
<b>Black, non-Hispanic</b>	11.9% (11.5%–12.3%)	11.4% (10.3%–12.5%)	5.3% (3.7%–7.5%)	3.4% (2.2%–5.2%)
<b>Hispanic</b>	16.3% (15.9%–16.7%)	16.2% (15.1%–17.3%)	19.4% (15.7%–23.6%)	13.4% (10.3%–17.1%)
<b>American Indian/Alaskan Native</b>	0.5% (0.5%–0.6%)	0.7% (0.5%–0.9%)	2.8% (1.5%–5.3%)	1.7% (1.1%–2.8%)
<b>Other</b>	7.4% (7.1%–7.6%)	4.7% (4.1%–5.5%)	4.0% (2.6%–6.1%)	4.0% (2.6%–6.3%)
<b>Income</b>				
<b>&lt;100% FPL</b>	14.0% (13.7%–14.4%)	19.3% (18.2–20.5%)	32.8% (28.2%–37.7%)	34.6% (29.7%–39.8%)
<b>&gt;100% &amp; &lt;200% FPL</b>	19.9% (19.6%–20.2%)	21.4% (20.0–22.9%)	24.6% (21.2%–28.3%)	31.2% (26.7%–36.1%)
<b>&gt;200% FPL</b>	66.1% (65.6%–66.6%)	59.3% (57.6%–60.9%)	42.6% (38.2%–47.1%)	34.2% (29.2%–39.5%)
<b>Reside in Rural County</b>	14.6% (14.2%–15.1%)	13.4% (12.4%–14.5%)	19.4% (15.8%–23.7%)	22.7% (18.4%–27.7%)
<b>Self-Reported Fair or Poor Health</b>	13.6% (13.3%–14.0%)	18.4% (16.9%–19.9%)	28.6% (23.8%–33.8%)	28.0% (23.8%–32.6%)
<b>Serious Psychological Distress</b>	10.0% (9.7%–10.2%)	30.1% (28.8%–31.5%)	37.4% (32.9%–41.7%)	52.4% (46.8%–58.0%)

Note: Estimates reflect weighted proportions based on survey methodology. Range reflects 95% confidence interval.

**Table 2.**

Unadjusted and adjusted estimates of service use by substance use category, United States 2015–2018

	No illicit opioid or methamphetamine use in past year	Illicit Opioid Use in Past Year	Methamphetamine Use in Past Year	Methamphetamine and Illicit Opioid Use in Past Year
<b>Unadjusted</b>				
Hospital days per 100 person-years (N, 95% CI)	45 (43–47)	65 (56–74) **	134 (73–195) *, <sup>a</sup>	170 (105–236) **, <sup>b</sup>
ED visits per 100 person-years (N, 95% CI)	48 (47–49)	84 (79–88) **	128 (102–153) **, <sup>c</sup>	150 (124–177) **, <sup>c</sup>
Housing instability (% 95% CI)	2.3% (2.2%–2.4%)	5.8% (5.2%–6.5%) **	9.1% (6.3%–11.9%) **, <sup>b</sup>	17.3% (13.8%–20.8%) **, <sup>c</sup>
Social service use (% 95% CI)	17.7% (17.3%–18.1%)	27.6% (26.0%–29.1%) **	44.2% (39.0%–49.3%) **, <sup>c</sup>	51.8% (46.0%–57.6%) **, <sup>c</sup>
Past year criminal justice involvement (% 95% CI)	2.5% (2.4%–2.6%)	10.4% (9.6%–11.1%) **	30.7% (25.4%–36.0%) **, <sup>c</sup>	42.3% (36.3%–48.4%) **, <sup>c</sup>
<b>Adjusted<sup>a</sup></b>				
Hospital days per 100 person-years (N, 95% CI)	47 (45–49)	70 (59–82) **	120 (62–177) *	139 (93–185) **, <sup>a</sup>
ED visits per 100 person-years (N, 95% CI)	49 (48–50)	70 (67–74) **	91 (75–107) **, <sup>a</sup>	102 (83–122) **, <sup>b</sup>
Housing instability (% 95% CI)	2.4% (2.3%–2.5%)	3.9% (3.4–4.4%) **	5.3% (3.7%–6.9%) **	8.4% (6.5%–10.3%) **, <sup>b</sup>
Social service use (% 95% CI)	18.0% (17.6%–18.4%)	23.4% (22.2%–24.6%) **	29.4% (25.5%–33.4%) **, <sup>b</sup>	33.1% (28.1%–38.0%) **, <sup>b</sup>
Past year criminal justice involvement (% 95% CI)	2.6% (2.5%–2.7%)	7.1% (6.5%–7.6%) **	19.1% (15.3%–22.8%) **, <sup>b</sup>	23.4% (18.9%–27.8%) **, <sup>b</sup>

Notes: Estimates reflect weighted proportions based on survey methodology.

<sup>a</sup> - adjusted for age, race/ethnicity, gender, poverty, rurality, serious psychological distress, and self-reported health\*  $P = .01$  compared to no past year illicit opioid or methamphetamine use\*\*  $P = .001$  compared to no past year illicit opioid or methamphetamine use<sup>a</sup>  $P = .04$  compared to illicit opioid use<sup>b</sup>  $P = .01$  compared to illicit opioid use<sup>c</sup>  $P = .001$  compared to illicit opioid use

**Table 3.**

Unadjusted and adjusted estimates of multi-sector service use by substance use category, United States 2015–2018

	No illicit Opioid or Methamphetamine use in past year	Illicit Opioid Use in Past Year	Methamphetamine Use in Past Year	Methamphetamine and Illicit Opioid Use in Past Year
<b>Unadjusted (95% CI)</b>				
0 sectors	69.4% (69.0%–69.8%)	52.6% (50.9%–54.3%) <sup>**</sup>	28.9% (24.4%–33.5%) <sup>**b</sup>	21.6% (17.4%–25.8%) <sup>**b</sup>
1 sector	24.2% (23.9%–24.5%)	31.5% (30.0%–32.9%) <sup>**</sup>	37.2% (31.7%–42.6%) <sup>**a</sup>	29.0% (24.6%–33.4%) <sup>*</sup>
2 or more sectors	6.4% (6.2%–6.6%)	15.9% (14.7%–17.1%) <sup>**</sup>	33.9% (29.4%–38.4%) <sup>**b</sup>	49.4% (44.1%–54.7%) <sup>**b</sup>
<b>Adjusted (95% CI)<sup>a</sup></b>				
0 sectors	69.0% (68.6%–69.5%)	58.4% (56.9%–59.9%) <sup>**</sup>	41.3% (56.9%–59.9%) <sup>**b</sup>	36.0% (31.1%–40.8%) <sup>**b</sup>
1 sector	24.4% (24.0%–24.7%)	28.7% (27.4%–30.0%) <sup>**</sup>	29.7% (24.4%–35.1%)	21.2% (17.5%–24.8%) <sup>b</sup>
2 or more sectors	6.6% (6.3%–6.8%)	11.6% (10.7%–12.6%) <sup>**</sup>	19.8% (17.3%–22.3%) <sup>**b</sup>	27.6% (23.5%–31.7%) <sup>**b</sup>

Notes: Estimates reflect weighted proportions based on survey methodology.

<sup>a</sup> - adjusted for age, race/ethnicity, gender, poverty, rurality, serious psychological distress, and self-reported health

<sup>\*</sup>  $P = .03$  compared to no past year illicit opioid or methamphetamine use

<sup>\*\*</sup>  $P = .001$  compared to no past year illicit opioid or methamphetamine use

<sup>a</sup>  $P = .04$  compared to illicit opioid use

<sup>b</sup>  $P = .001$  compared to illicit opioid use