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### Title

Mortality Risk Following Nonfatal Injuries With Alcohol Use Disorder Involvement: A One-Year Follow-Up of Emergency Department Patients Using Linked Administrative Data.

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**Title:** Mortality risk following non-fatal injuries with alcohol use disorder involvement: A one-year follow-up of emergency department patients using linked administrative data

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## **ABSTRACT**

**Objective.** Patient presentations to the emergency department (ED) for alcohol-involved injury represent a growing public health burden, but their characteristics and sequelae remain understudied.

This study examined mortality rates among ED patients presenting with alcohol-involved injuries, and assessed how mortality varied by injury intent and other characteristics.

**Method.** This retrospective cohort study used statewide, longitudinally-linked ED patient record and mortality data from California. Participants comprised all residents presenting to a licensed ED in 2009-2012 with a nonfatal injury that involved comorbid diagnosis of alcohol use disorder (AUD; n=261,222; 59.3% male). Injury intent was defined using International Classification of Diseases, 9<sup>th</sup> Revision external cause-of-injury codes. Cox regression was used to investigate factors associated with 12-month all-cause mortality rates. Age-, sex-, and race/ethnicity-adjusted standardized mortality ratios (SMRs) were calculated using statewide mortality data.

**Results.** Most ED injury visits involving an AUD diagnosis were coded as unintentional (75.9%). Following the index ED visit, all-cause mortality among AUD-involved injury patients was 5,205 per 100,000 person-years, five times higher than the demographically matched population (SMR: 5.3; 95% CI: 5.2, 5.4). Adjusted Cox regression models indicated that patients whose index injury was unintentional, and whose AUD was for acute intoxication, had significantly higher mortality. Most deaths among unintentionally-injured patients were from natural causes, while external-cause deaths were relatively more common in the other patient groups.

**Conclusions.** AUD-involved injury presentations to the ED are common and associated with high patient mortality burden, which varies by injury intent. Interventions are needed to reduce excess mortality in these patients.

Alcohol is the most commonly used intoxicant in the United States and is responsible for significant public health burden in terms of both morbidity and mortality (Substance Abuse and Mental Health Services Administration, 2019). Concerningly, research suggests that alcohol consumption, problematic alcohol use, and alcohol-related deaths have increased substantially in the U.S. over the past 20 years, perhaps especially for women (Shmulewitz et al., 2021; Spillane et al., 2020; White et al., 2018, 2020). Problematic alcohol use can lead to serious health consequences, including liver disease and cancer in the long term and significantly elevated risk of injury in the short term, including injuries serious enough to require emergency care (Cherpitel, 2009; Chikritzhs and Livingston, 2021). Rates of alcohol-involved injury ED visits, and the costs associated with such visits, appear to be rising along with other public health indicators of problematic alcohol use (Dimaggio et al., 2021).

Emergency departments may represent a key context for helping close enduring treatment gaps among people with problematic alcohol use through screening, initiating treatment, and linking them to outpatient care (Hawk and D'Onofrio, 2018). Brief ED-based interventions have been shown to reduce future alcohol consumption and related consequences, including alcohol-related injuries, while remaining cost-effective (Barata et al., 2017; D'Onofrio et al., 2012; D'Onofrio and Degutis, 2002; Gentilello et al., 2005; Landy et al., 2016; Schmidt et al., 2016; White et al., 2018). However, although an estimated 30% of injured ED patients screen positive (via breath or blood tests) for alcohol involvement (Gentilello et al., 2005) and up to 40% of individuals with moderate to severe alcohol use disorders (AUD) report making an ED visit in the past year (Mintz et al., 2021), only 15% of ED trauma centers have formal alcohol screening and intervention policies, despite widespread support for implementing such policies (Cunningham et al., 2010).

To appropriately target ED-based interventions for the prevention of morbidity and mortality, more information is needed about injury patients with AUD involvement, their injuries, and their

subsequent mortality experiences (Dimaggio et al., 2021). Previous work has shown that alcohol involvement increases the risk of in-ED mortality among injured patients, but this likely represents a substantial underestimate of their near-term mortality risk (Cornwell et al., 1998). Other studies, all from international settings, have found excess all-cause mortality among ED patients presenting with alcohol use disorders, but these studies did not focus specifically on alcohol involvement among injury patients (Gunnarsdottir et al., 2014; Hulme et al., 2020; Kendler et al., 2016). No U.S.-based study that we are aware of has examined all-cause or cause-specific mortality rates among AUD-involved injury patients in ED settings.

Another major gap in the field is the lack of empirical data on the distribution of injury intent among AUD-involved injury ED patients, and how injury intent is related to these patients' mortality risk. Many injuries coded as intentional self-harm or assault involve alcohol (Goldman-Mellor et al., 2019; Kool et al., 2018), but no study we are aware of has examined what proportion of AUD-involved injuries are of accidental vs. deliberate self-harm, assault, or undetermined intent. Moreover, no study has examined variability in patients' mortality experiences according to their injury intent. This knowledge gap is important because research has shown that the documented intent of substance-related ED visits can be strongly associated with subsequent mortality risks in those patients (Olfson et al., 2020).

The current study used ED patient data from California, a large state with rigorous injury intent coding practices, to determine the relative frequency of coded intent (unintentional, assault, deliberate self-harm, or undetermined) among AUD-involved injury visits. We also used linked mortality data to estimate subsequent mortality rates among patients with such injuries, and examined how those death rates varied by injury intent and other patient characteristics.

## **METHODS**

### **Data**

We obtained discharge data from the California Office of Statewide Health Planning and Development (OSHPD) on all visits between 2009-2012 to all California-licensed EDs by individuals aged  $\geq 10$  years with a California residential zip code. OSHPD also provided information on all individuals in this ED cohort to the California Department of Public Health Vital Records, which assessed vital status in California death records and provided information on the date and underlying cause of death for all matching decedents who died in 2009-2013 (excluding those who died out of state,  $<1\%$  of the total), the most recent years of mortality data available at the time of this analysis. Probabilistic linkage matching was implemented based on the patient's social security number (SSN), gender, birth date, race/ethnicity, and zip code of residence. All data obtained and used by the study team were de-identified. The Institutional Review Boards of the California Health and Human Services Agency and the University of California, Merced, approved this study.

For the current study, we first retained all patient visits coded as involving an external-cause injury (defined as those with an *International Classification of Diseases*, Ninth Revision, Clinical Modification (ICD-9-CM) E-code in any diagnostic position). California has mandated 100% reporting of external cause-of-injury codes since 1990. We then assessed comorbid AUD involvement at each visit, defined as the presence of an ICD-9-CM code in any diagnostic position corresponding to alcoholic psychosis (291), alcohol abuse (305.0, 303.0), alcohol dependence syndrome (303.9), alcohol poisoning (980.0, 980.1, 980.9, E860.0, E860.1, E860.2, E860.9), or excessive blood levels of alcohol (790.3) (Centers for Disease Control and Prevention, 2021). We use the term "AUD-involved injury" throughout with the recognition that we did not have access to patient blood alcohol content (BAC)

information, and that not all AUD-diagnosed patients were necessarily consuming alcohol at the time of their injury.

All subsequent analyses were restricted to qualifying index visits for AUD-involved injury among patients aged  $\geq 10$  years in 2009-2012, defined as the patient's first qualifying visit during the study period. For visits resulting in patient discharge or transfer to another facility, the index date was the date of ED presentation. For visits that resulted in a same-hospital admission, the index date was the date of discharge from the associated hospitalization (Olfson et al., 2017). Visits that lacked SSNs, or patients whose index visit resulted in death, were excluded from follow-up analyses.

## **Measures**

The primary outcome was death within 12 months of the index date by any cause, identified through linkage with the state Vital Records. This follow-up period was chosen to maximize the available data and because ED-based alcohol interventions have demonstrated effectiveness for up to 12 months (Barata et al., 2017; D'Onofrio et al., 2012; Tanner-Smith and Lipsey, 2015).

Patient demographic characteristics were examined for descriptive purposes and to calculate hazard ratios. These characteristics included gender (male, female), age group (10-24, 25-44, 45-64,  $\geq 65$  years), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, Asian/Pacific Islander, other), insurance status (private, Medicaid, Medicare, self-pay/other). We also assessed the intent and disposition of the index injury. Injury intent, based on the E-code in the primary diagnostic position, was defined as unintentional (E000-E949), deliberate self-harm (E950-E959), assault (E960-E979), or undetermined (E980-E989). Disposition was coded as routine discharge home, admitted as an inpatient, or other; patients who died were excluded from follow-up analyses. Lastly, we classified the patient's index AUD diagnosis type according to their first-listed AUD diagnosis code (where there were multiple

such codes), into categories of “alcohol abuse or dependence” or “acute alcohol poisoning” (which included alcohol poisoning, alcoholic psychosis, and excessive blood levels of alcohol).

## **Analyses**

Crude mortality rates per 100,000 person-years of follow-up were calculated for all-cause mortality in the year after the index date. Individuals who did not link to California mortality records from 365 days after the index date were presumed alive for this period. Decedents were treated as censored on their death date. For calculation of standardized mortality ratios, data on death by manner for California overall in 2009-2013 were obtained from the Center for Disease Control’s WONDER system (Centers for Disease Control and Prevention (National Center for Health Statistics), 2017).

Mortality rates according to patient age, gender, race/ethnicity, insurance status, index AUD diagnosis type, and index injury intent were compared using Cox proportional hazards regression. All variables were entered into one adjusted model to assess their unique contributions to all-cause mortality risk. We also examined the relative contribution of natural causes (ICD-10 cause-of-death codes A00-R99, Z00-Z99, U00-U49, or U82-U85) versus external causes (codes S00-Y98) to overall mortality.

Lastly, we assessed whether the association between injury intent and mortality risk varied by gender, first using gender-stratified SMRs and Cox proportional hazards models (controlling for other demographic factors) and then specifying a combined model with an interaction term between injury intent and gender. All statistical analyses were conducted using Stata 14.0 (StataCorp LP).

## **RESULTS**

Californians aged  $\geq 10$  years made 10,059,640 million ED visits for injury between 2009-2012. Approximately 4% of these visits (n=388,565 visits; 3.9%) had a comorbid diagnosis indicating alcohol



involvement. Three-quarters of these AUD-involved injuries were coded as unintentional (75.9%), with 14.1% due to assault, 7.7% due to self-harm, and 2.3% of undetermined intent. Male patients accounted for two-thirds of all AUD-involved injury visits (62.5%), but this proportion varied considerably by injury intent (**Table 1**). Patient age, race/ethnicity, insurance status, and visit disposition distributions also varied substantially by injury intent.

There were 263,657 unique patients with a qualifying index AUD-involved injury in 2009-2012. Of those, 2,435 (0.9%) died on the day of their index visit and were excluded from follow-up analyses, leaving 261,222 patients with qualifying non-fatal index injuries. The proportions with an index injury of unintentional, assault, self-harm, or undetermined intent were very similar to those in the all-visits sample (76.9%, 13.2%, 7.9%, and 2.1%, respectively). Of these 261,222 AUD-involved injury patients, a total of 13,175 died within 12 months of their index visit, resulting in an all-cause mortality rate of 5,204.6 per 100,000 (**Table 2**). This rate was five times higher than that of the demographically matched California population (SMR: 5.3 [95% CI: 5.2, 5.4]). Most of the deaths in our cohort were due to natural causes (n=11,021; 83.7%), predominantly from circulatory system disease (n=3,653; 33.2% of all natural-cause deaths), cancer (n=2,213; 20.1%), or digestive system diseases (n=1,550; 14.1%). Of the remaining 2,154 deaths that were due to external causes, the majority were comprised of unintentional injuries (n=1,498; 69.6%), with suicide accounting for 20.1% (n=433), and homicide 5.5% (n=119).

In a Cox proportional hazards model that included all predictor variables, the all-cause mortality rate among AUD-involved injury patients increased with patient age, male gender, and White race/ethnicity. Compared to patients with private insurance at index visit, those with Medicaid had 71%

( $HR_{adj}=1.71$ , 95% CI=1.61, 1.81) and those with Medicare had 58% ( $HR_{adj}=1.58$ , 95% CI=1.47, 1.62) greater risks of dying during follow-up.

Mortality risk was also associated with index injury intent (**Table 2** and **Figure 1**). Patients whose index AUD-involved injury was unintentional had the highest crude mortality rate, at 6,212 per 100,000; this corresponded to an SMR of 5.28 (95% CI=5.19, 5.38). Compared to unintentionally-injured patients and adjusting for patient age, gender, race/ethnicity, and insurance status, patients whose index injuries were coded as deliberate self-harm or assault were less likely to die during follow up ( $HR_{adj}=0.81$ , 95% CI=0.74, 0.89; and  $HR_{adj}=0.58$ , 95% CI=0.53, 0.64, respectively). Self-harm patients had an SMR of 6.31 (95% CI=5.75, 6.92), while assault-injured patients had an SMR of 4.43 (95% CI=4.04, 4.85). Patients whose index AUD-involved injuries were coded as “undetermined intent” were more likely than unintentionally-injured patients to die after accounting for confounders ( $HR_{adj}=1.33$ , 95% CI=1.17, 1.52); they also had the highest SMR (9.24; 95% CI=8.11, 10.49).

The relative contribution of natural causes versus external causes to overall mortality varied by index injury intent (**Figure 1**). Natural-cause deaths accounted for the vast majority (87.0%; n=10,454) of deaths among patients whose index injuries were unintentional. Many of these deaths were due to ischemic heart disease (16%), liver disease (11%), and respiratory diseases like chronic obstructive pulmonary disease (11%). By contrast, only 54% (n=253) of deaths in the assault-injured AUD group were due to natural causes, and just 39% (n=177) in the self-harm intent group. For the undetermined-intent injury group, 57% of deaths (n=137) were due to natural causes, and 43% (n=102) to external causes.

Mortality risk also varied by the AUD recorded at the index injury. Compared to patients whose index AUD diagnosis was for alcohol abuse or dependence, those whose AUD diagnosis was for acute

alcohol intoxication had a 33% higher mortality rate ( $HR_{adj}=1.33$ , 95% CI=1.28, 1.38), even accounting for patient sociodemographic characteristics and injury intent. These groups' SMRs also differed slightly: mortality among patients with an AUD for alcohol abuse/dependence was approximately 5 times higher than that among the demographically matched California population (SMR=4.98; 95% CI=4.86, 5.10), while mortality among patients with alcohol intoxication was 5.7 times higher than the demographically matched population (SMR=5.69; 95% CI=5.55, 5.83).

The relationship between injury intent and all-cause mortality differed slightly for male vs. female patients (**Table 3**). A self-harm injury was associated with reduced mortality risk for both sexes (female  $HR_{adj}=0.72$ , 95% CI=0.62, 0.83; male  $HR=0.88$ , 95% CI=0.78, 1.03;  $p$  for interaction = 0.051). While the mortality risk reduction associated with an assault injury was evident for both genders, the magnitude of this reduction was greater for males (male  $HR_{adj}=0.53$ , 95% CI=0.47, 0.59; female  $HR=0.71$ , 95% CI=0.61, 0.82;  $p$  for interaction < 0.001). Gender differences in the association between undetermined-intent injury and mortality risk were not statistically significant ( $p$  for interaction=0.59). Mortality rates among female injury patients with AUD involvement were 4.8 times higher than the age- and race/ethnicity-matched California population (SMR=4.84, 95% CI=4.71, 4.97), while mortality rates among male patients were 5.7 times higher than the demographically matched population (SMR=5.70, 95% CI=5.57, 5.82).

## DISCUSSION

This study is the first population-based analysis from the US to assess mortality rates and injury intent among patients presenting to the emergency department with an AUD-involved injury. Our findings indicate that only a small proportion of injury ED patient visits involve a documented diagnosis

of alcohol disorder, but that in this patient group, one in twenty patients die within 12 months of their index ED visit. All-cause mortality risk was particularly elevated for AUD-involved injury patients who were older and those of non-Hispanic White race/ethnicity, as well as those covered by Medicaid or Medicare. Our findings also contribute to the literature by showing that most AUD-involved injury visits stem from unintentional injuries, but substantial proportions resulted from assault (14%) or deliberate self-harm (7.7%), and that mortality risk among AUD-involved injury patients differs by the intent of the index injury. Unintentionally injured patients were at highest risk. These findings highlight the potential value of more aggressive models of post-discharge follow-up services, such as case management and assertive outreach, in this specific patient population (Parkman et al., 2017a; Pasetti et al., 2016).

Previous estimates of the proportion of ED visits involving alcohol have ranged from 3% to 38% (Bernstein et al., 2007; Gentilello et al., 2005), depending on the sample and assessment method for alcohol involvement, which often comprised breath- or blood-alcohol content assays. Our analysis focused specifically on ED visits for injury, limiting comparability with prior work. Moreover, we relied upon ICD-9-CM AUD diagnoses documented in administrative patient data, which may substantially undercount patients' alcohol misuse; our estimate is thus likely to be conservative (McKenzie et al., 2010; Rockett et al., 2003; Solomon et al., 1980). This underscores the importance of universal alcohol screening and intervention policies in ED settings (Cunningham et al., 2010).

The finding that relatively substantial proportions of AUD-involved injury ED visits are due to assault or intentional self-harm is consistent with research showing that high proportions of assault victims and suicide attempters were consuming alcohol at the time of their injuries, and that alcohol may function in these situations to lower inhibitions and increase risk-taking behavior (Giancola et al., 2011; Norström and Rossow, 2016; Roizen, 1997). For these assault- and self-harm-injured AUD patients,

ED-based violence and suicide prevention interventions may be warranted (Fleischmann, 2008; Mercer Kollar et al., 2020; Miller et al., 2017; Stanley et al., 2018). Interventions targeting hospitalized patients may not reach all relevant patients; in our data, only 23% of assault-injured patients, and 69% of self-harm patients, were admitted as inpatients, consistent with national data (Centers for Disease Control and Prevention, 2020).

We also found, however, that unintentionally-injured patients had the highest all-cause 12-month mortality rate. Although we attempted to statistically account for group differences in age, gender, race/ethnicity, and insurance status, a high proportion of unintentionally-injured patients with AUD were over the age of 45 (57.2%, compared to 34.4% and 27.0% among self-harm and assault-injured patients, respectively), which likely contributed to their high mortality rate. Almost 90% of the deaths in this group were from natural causes, compared to much smaller proportions in the assault-injured (54%) and self-harm (39%) AUD groups. This patient group may disproportionately suffer from complex comorbid medical conditions that elevate their risk for compromised functioning across multiple organ systems. If so, it is possible that these conditions are related to chronic excessive consumption of alcohol over long periods, but we could not assess this directly in our data. For such patients, integrated care models that coordinate general medical care with addiction treatment may be valuable (Savic et al., 2017; Wakeman et al., 2019).

According to clinical guidelines in the U.S. (Center for Substance Abuse Treatment, 2009) and elsewhere (National Collaborating Centre for Mental Health (UK), 2011), patients for whom there is evidence of severe AUD or alcohol-related impairment should be referred for specialist treatment, medication management support, and other services (Simioni et al., 2015). However, many patients with AUD experience steep barriers when trying to access addiction specialists – including both structural barriers, such as long wait times to enter residential treatment facilities and provider stigmatization of

AUD (Parkman et al., 2017b; Williams et al., 2018), as well as individual attitudinal barriers, such as thinking the problem would get better on its own (Oleski et al., 2010; Parkman et al., 2017b). Large proportions of ED patients who report willingness to receive post-discharge interventions do not make it to their first post-discharge appointments (Parkman et al., 2017a; Simioni et al., 2015). These challenges are even more pronounced for patients who are unhoused, lack transportation, have low incomes, or who have comorbid health conditions that limit their mobility. Low-barrier, accessible outpatient addiction services may facilitate these patients' entry into treatment and reductions in hazardous drinking (Wiercigroch et al., 2020).

Few direct comparisons between our results and those of other studies are possible, as most U.S.-based studies on mortality among AUD patients are decades old or involved highly selected patient samples (Roerecke and Rehm, 2013). The closest analog of which we are aware is a 2012 study by Callaghan and colleagues (Callaghan et al., 2012), which used linked inpatient and mortality data on hospitalized patients with AUD from California and reported an all-cause mortality rate of nearly 4,900 per 100,000 — very similar to our estimated rate. Data from other countries also offer a comparison; in Denmark, a recent study found that the 12-month cumulative incidence of all-cause mortality among AUD patients at their first hospital contact was 5.2% – a rate again very similar to ours (Askgaard et al., 2020).

We found that crude mortality rates among male and female patients with alcohol involvement were fairly similar, although males had higher mortality after adjustment for age and other sociodemographic factors. Gender-specific mortality rates also varied somewhat by patient injury intent. Other studies have reported that among patients with AUD, standardized mortality ratios appear to be higher among female patients compared to males (Roerecke and Rehm, 2014). Our study design and patient population differed from those in previous studies, and notably included a large number of

female patients, which could explain this inconsistency. Future research should examine gender-specific mortality patterns among AUD patients in ED and other clinical treatment settings.

## **Limitations**

Our study had several important advantages, including a large population-based cohort of ED patients, from the largest and most diverse U.S. state, comprehensive coding of external cause of injury, which is not available in all states, and inclusion of mortality outcomes from validated high-quality registers, which are also not available in all states. However, several limitations should be considered when interpreting the results. During the study period, clinical diagnoses were made under ICD-9-CM, which used separate E-codes to document injury intent; our results may therefore not generalize to ED presentations using ICD-10-CM, which combines external cause of injury codes with diagnostic codes. Because the sociodemographic characteristics of California differ from those of other states, the results may not generalize to the entire United States. Mortality data for ED patients who died outside of California were not available for this study; we expect this artifact resulted in a slight downward bias on the absolute mortality rates calculated for the ED patients. We could not assess alcohol involvement through breath tests, blood alcohol content, or other means other than diagnostic coding, and our estimate is therefore likely to be conservative. Furthermore, our administrative data set lacked other important information, such as patient injury severity, medication use, and socioenvironmental risk factors, that could have informed our risk estimates.

## **Conclusions**

AUD-involved injury presentations to the ED are common and associated with high patient mortality burden. Mortality risk varies not just according to patient sociodemographic characteristics, but also by injury intent. Implementation of universal alcohol screening in ED settings, as well as improved linkage to outpatient care, could help to reduce excess mortality in these vulnerable patients.



**Table 1. Characteristics of AUD-involved injury visits treated in California emergency departments (2009-2012).**

Characteristic	All AUD-involved injury visits		Unintentional injury visits		Deliberate self-harm injury visits		Assault injury visits		Undetermined intent injury visits	
	N	%	N	%	N	%	N	%	N	%
All	388,565	100	294,848	100	29,910	100	54,806	100	9,001	100
Sex										
Male	242,883	62.5%	179,692	60.9%	13,302	44.5%	44,450	81.1%	5,439	60.4%
Female	145,682	37.5%	115,156	39.1%	16,608	55.5%	10,356	18.9%	3,562	39.6%
Age group (years)										
10-24	65,735	16.9%	41,953	14.2%	6,437	21.5%	15,276	27.9%	2,069	23.0%
25-44	125,611	32.3%	84,244	28.6%	13,171	44.0%	24,746	45.2%	3,450	38.3%
45-64	144,162	37.1%	117,381	39.8%	9,607	32.1%	14,065	25.7%	3,109	34.5%
≥ 65	53,057	13.7%	51,270	17.4%	695	2.3%	719	1.3%	373	4.1%
Race/ethnicity										
NH White	218,646	56.3%	172,115	58.4%	19,245	64.3%	22,238	40.6%	5,048	56.1%
NH Black	35,866	9.2%	26,145	8.9%	1,884	6.3%	6,935	12.7%	902	10.0%
Hispanic	104,714	27.0%	74,592	25.3%	6,661	22.3%	21,054	38.4%	2,407	26.7%
NH Asian/Pacif. Isl.	10,116	2.6%	8,187	2.8%	688	2.3%	1,069	2.0%	172	1.9%
NH other race	19,223	5.0%	13,809	4.7%	1,432	4.8%	3,510	6.4%	472	5.2%
Payer										
Private	107,302	27.7%	84,381	28.7%	10,311	34.5%	10,110	18.5%	2,500	27.8%
Medicaid	91,502	23.6%	65,926	22.4%	7,777	26.0%	15,395	28.1%	2,404	26.7%
Medicare	66,605	17.2%	59,898	20.3%	2,894	9.7%	2,748	5.0%	1,065	11.8%
Self-pay	107,933	27.8%	73,806	25.1%	7,935	26.5%	23,469	42.8%	2,723	30.3%
Other/unknown	14,782	3.8%	10,423	3.5%	981	3.3%	3,073	5.6%	305	3.4%
Intent of injury										
Unintentional	294,848	75.9%	—	—	—	—	—	—	—	—
Self-harm	29,910	7.7%	—	—	—	—	—	—	—	—
Assault	54,806	14.1%	—	—	—	—	—	—	—	—
Undetermined	9,001	2.3%	—	—	—	—	—	—	—	—
Disposition										
Discharged home	232,728	59.9%	179,304	60.8%	8,468	28.3%	39,768	72.6%	5,188	57.6%
Admitted	144,172	37.1%	107,332	36.4%	20,693	69.2%	12,579	23.0%	3,568	39.6%
Other	8,440	2.2%	5,345	1.8%	608	2.0%	2,362	4.3%	125	1.4%
Died	3,225	0.8%	2,867	1.0%	141	0.5%	97	0.2%	120	1.3%

**Table 2. 12-month mortality rates among 261,222 ED patients with an index non-fatal AUD-involved injury in California, 2009-2012.**

Characteristic	12-month all-cause mortality rate per 100,000 person-years			Adjusted Cox proportional hazards model for 12-month all-cause mortality	
	Number of deaths	Rate	95% CI	HR <sub>adj</sub> <sup>b</sup>	95% CI
All	13,175	5204.6	5116.5, 5294.2	—	—
Age group <sup>a</sup>					
10-24 years	193	460.8	400.2, 530.6		
25-44 years	1,230	1478.4	1398.1, 1563.4	1.05	1.051, 1.053
45-64 years	5,185	5694.6	5541.7, 5851.7		
≥ 65 years	6,567	17742.7	17318.7, 18177.1		
Sex					
Male	7,881	5247.9	5133.3, 5365.0	1.61	1.55, 1.67
Female	5,294	5141.4	5004.8, 5281.8	1.0	(ref.)
Race/ethnicity					
NH White	9,312	6345.8	6218.2, 6476.0	1.0	(ref.)
NH Black	1,050	4044.5	3807.1, 4296.7	0.87	0.81, 0.92
Hispanic	2,025	3342.5	3200.1, 3491.3	0.82	0.78, 0.86
NH Asian	396	5405.0	4898.0, 5964.5	0.82	0.74, 0.90
NH Other	392	3128.6	2833.8, 3454.2	0.77	0.69, 0.85
Payer					
Private	2,695	3433.6	3306.4, 3565.7	1.0	(ref.)
Medicaid	2,317	4071.7	3909.2, 4240.9	1.71	1.61, 1.81
Medicare	6,678	15220.3	14859.6, 15589.8	1.55	1.47, 1.62
Self-pay	1,236	1930.7	1826.0, 2041.3	0.96	0.89, 1.03
Other/unknown	240	2526.7	2226.4, 2867.4	1.01	0.88, 1.15
Intent of injury					
Unintentional	12,012	6211.6	6101.5, 6323.7	1.0	(ref.)
Self-harm	454	2240.8	2043.9, 2456.7	0.81	0.74, 0.89
Assault	470	1374.9	1256.1, 1505.0	0.58	0.53, 0.64
Undetermined	239	4494.7	3959.5, 5102.3	1.33	1.17, 1.52
AUD diagnosis type					
Alcohol abuse or dependence	6,789	3,809.0	3719.4, 3900.7	1.0	
Acute alcohol intoxication	6,292	8,424.6	8219.0, 8635.4	1.33	1.28, 1.38

<sup>a</sup> Age was entered as a continuous variable in the Cox proportional hazards model.

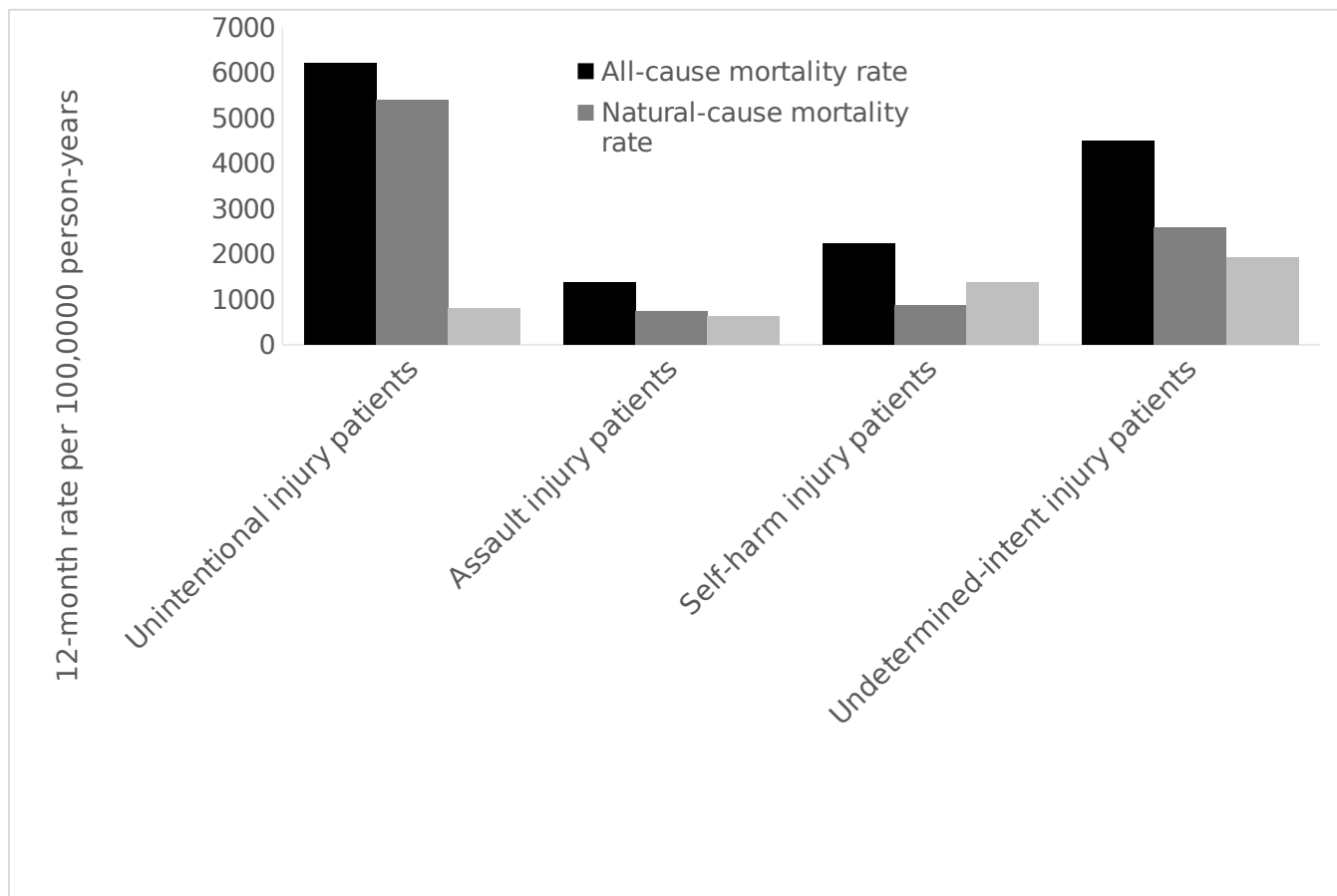
<sup>b</sup> Adjusted HR model controls for all variables shown in the table.

**Table 3. Associations between injury intent and 12-month all-cause mortality for male and female patients.**

	12-month all-cause mortality rate per 100,000 person-years			Adjusted Cox proportional hazards model for 12-month all-cause mortality	
	Number of deaths	Rate	95% CI	HR <sub>adj</sub> <sup>a</sup>	95% CI
<b>Male patients</b>					
Intent of injury					
Unintentional	7,094	6372.7	6226.1, 6522.7	1.0	(ref.)
Self-harm	259	2998.2	2654.4, 3386.5	0.91	0.80, 1.03
Assault	366	1349.0	1217.6, 1494.5	0.53	0.47, 0.58
Undetermined	162	5250.1	4500.8, 6124.1	1.43	1.22, 1.67
<b>Female patients</b>					
Intent of injury					
Unintentional	4,918	5993.1	5827.9, 6162.9	1.0	(ref.)
Self-harm	195	1677.9	1458.1, 1930.7	0.71	0.61, 0.82
Assault	104	1474.7	1216.8, 1787.2	0.72	0.59, 0.88
Undetermined	77	3450.3	2759.7, 4313.8	1.23	0.98, 1.54

<sup>a</sup> Adjusted for age, race/ethnicity, and payer at index visit.

**FIGURE 1.** Rates of all-cause mortality, natural-cause mortality, and external-cause mortality among AUD-involved injury patients, according to intent of index injury.



## References

- Askgaard, G., Leon, D. A., Deleuran, T., and Tolstrup, J. S. (2020). Hospital admissions and mortality in the 15 years after a first-time hospital contact with an alcohol problem: A prospective cohort study using the entire Danish population. *International Journal of Epidemiology*, 49(1), 94–102. doi: 10.1093/ije/dyz159
- Barata, I. A., Shandro, J., Montgomery, M., Polansky, R., Sachs, C. J., Duber, H. C., Weaver, L., et al. (2017). Effectiveness of SBIRT for alcohol use disorders in the emergency department: A systematic review. *Western Journal of Emergency Medicine*, 18(6), 1143–1152.
- Bernstein, E., Bernstein, J., Feldman, J., Fernandez, W., Hagan, M., Mitchell, P., Safi, C., et al. (2007). The impact of screening, brief intervention, and referral for treatment on emergency department patients' alcohol Use. *Annals of Emergency Medicine*, 50(6). doi: 10.1016/j.annemergmed.2007.06.486
- Callaghan, R. C., Cunningham, J. K., Verdichevski, M., Sykes, J., Jaffer, S. R., and Kish, S. J. (2012). All-cause mortality among individuals with disorders related to the use of methamphetamine: A comparative cohort study. *Drug and Alcohol Dependence*, 125(3), 290–294. Elsevier Ireland Ltd. doi: 10.1016/j.drugalcdep.2012.03.004
- Center for Substance Abuse Treatment. (2009). *Incorporating Alcohol Pharmacotherapies Into Medical Practice. Treatment Improvement Protocol (TIP) Series 49. HHS Publication No. (SMA) 09-4380.* (Vol. 114). Rockville, MD.
- Centers for Disease Control and Prevention. (2020). Web-based Injury Statistics Query and Reporting System (WISQARS): Non-fatal injury reports. *National Center for Injury Prevention and Control*. Retrieved March 27, 2021, from [www.cdc.gov/ncipc/wisqars](http://www.cdc.gov/ncipc/wisqars)
- Centers for Disease Control and Prevention. (2021). Alcohol-Related ICD Codes. Retrieved August 3, 2021, from <https://www.cdc.gov/alcohol/ardi/alcohol-related-icd-codes.html>
- Centers for Disease Control and Prevention (National Center for Health Statistics). (2017). Compressed Mortality File 1999-2016 on CDC WONDER Online Database. Retrieved September 20, 2002, from <https://wonder.cdc.gov/cmfi/icd10.html>
- Cherpitel, C. J. (2009). *Alcohol and injuries: emergency department studies in an international perspective*. World Health Organization.
- Chikritzhs, T., and Livingston, M. (2021). Alcohol and the risk of injury. *Nutrients*, 13(8), 1–15. doi: 10.3390/nu13082777
- Cornwell, E. E., Belzberg, H., Velmahos, G., and Chan, L. S. (1998). The prevalence and effect of alcohol and drug abuse on cohort-matched critically injured patients. *The American Surgeon*, 64(5), 461. Southeastern Surgical Congress.
- Cunningham, R. M., Harrison, S. R., McKay, M. P., Mello, M. J., Sochor, M., Shandro, J. R., Walton, M. A., et al. (2010). National survey of emergency department alcohol screening and intervention practices. *Annals of Emergency Medicine*, 55(6), 556–562. Elsevier Inc. doi: 10.1016/j.annemergmed.2010.03.004
- D'Onofrio, G., and Degutis, L. C. (2002). Preventive care in the emergency department: Screening and brief intervention for alcohol problems in the emergency department: A systematic review. *Academic Emergency Medicine*, 9(6), 627–638. doi:

10.1197/aemj.9.6.627

- D'Onofrio, G., Fiellin, D. A., Pantalon, M. V, Chawarski, M. C., Owens, P. H., Degutis, L. C., Busch, S. H., et al. (2012). A brief intervention reduces hazardous and harmful drinking in emergency department patients. *Annals of Emergency Medicine*, 60(2), 181-192. Elsevier.
- Dimaggio, C. J., Avraham, J. B., Frangos, S. G., and Keyes, K. (2021). The role of alcohol and other drugs on emergency department traumatic injury mortality in the United States. *Drug and Alcohol Dependence*, 225(March).
- Fleischmann, A. (2008). Effectiveness of brief intervention and contact for suicide attempters: a randomized controlled trial in five countries. *Bulletin of the World Health Organization*, 86(9), 703-709. doi: 10.2471/blt.07.046995
- Gentilello, L. M., Ebel, B. E., Wickizer, T. M., Salkever, D. S., and Rivara, F. P. (2005). Alcohol interventions for trauma patients treated in emergency departments and hospitals: A cost benefit analysis. *Annals of Surgery*, 241(4), 541-550. doi: 10.1097/01.sla.0000157133.80396.1c
- Giancola, P. R., Duke, A. A., and Ritz, K. Z. (2011). Alcohol, violence, and the alcohol myopia model: Preliminary findings and implications for prevention. *Addictive Behaviors*, 36(10), 1019-1022. doi: <https://doi.org/10.1016/j.addbeh.2011.05.006>
- Goldman-Mellor, S. J., Olfson, M., Lidon-Moyano, C., and Schoenbaum, M. (2019). Association of suicide and other mortality with emergency department presentation. *JAMA Network Open*, 2(12), e1917571. doi: 10.1001/jamanetworkopen.2019.17571
- Gunnarsdottir, A. S., Kristbjornsdottir, A., Gudmundsdottir, R., Gunnarsdottir, O. S., and Rafnsson, V. (2014). Survival of patients with alcohol use disorders discharged from an emergency department: A population-based cohort study. *BMJ Open*, 4(12), 9-12. doi: 10.1136/bmjopen-2014-006327
- Hawk, K., and D'Onofrio, G. (2018). Emergency department screening and interventions for substance use disorders. *Addiction Science and Clinical Practice*, 13(1), 1-6. BioMed Central. doi: 10.1186/s13722-018-0117-1
- Hulme, J., Sheikh, H., Xie, E., Gatov, E., Nagamuthu, C., and Kurdyak, P. (2020). Mortality among patients with frequent emergency department use for alcohol-related reasons in Ontario: A population-based cohort study. *Canadian Medical Association Journal*, 192(47), E1522-E1531. doi: 10.1503/cmaj.191730
- Kendler, K. S., Ohlsson, H., Sundquist, J., and Sundquist, K. (2016). Alcohol Use Disorder and Mortality Across the Lifespan: A Longitudinal Cohort and Co-relative Analysis. *JAMA Psychiatry*, 0126, 1-7. doi: 10.1001/jamapsychiatry.2016.0360
- Kool, B., Buller, S., Kuriyan, R., Jones-Todd, C. M., Newcombe, D., and Jones, P. (2018). Alcohol and injury among attendees at a busy inner city New Zealand emergency department. *Injury*, 49(4), 798-805. doi: 10.1016/j.injury.2018.02.028
- Landy, M. S. H., Davey, C. J., Quintero, D., Pecora, A., and McShane, K. E. (2016). A systematic review on the effectiveness of brief interventions for alcohol misuse among adults in emergency departments. *Journal of Substance Abuse Treatment*, 61, 1-12. Elsevier.

- McKenzie, K., Harrison, J. E., and McClure, R. J. (2010). Identification of alcohol involvement in injury-related hospitalisations using routine data compared to medical record review. *Australian and New Zealand Journal of Public Health*, 34(2), 146–152. doi: 10.1111/j.1753-6405.2010.00499.x
- Mercer Kollar, L. M., Sumner, S. A., Bartholow, B., Wu, D. T., Moore, J. C., Mays, E. W., Atkins, E. V, et al. (2020). Building capacity for injury prevention: a process evaluation of a replication of the Cardiff Violence Prevention Programme in the Southeastern USA. *Injury Prevention*, 26(3), 221–228. doi: 10.1136/injuryprev-2018-043127
- Miller, I. W., Camargo, C. A., Arias, S. A., Sullivan, A. F., Allen, M. H., Goldstein, A. B., Manton, A. P., et al. (2017). Suicide prevention in an emergency department population. *JAMA Psychiatry*, 74(6), 563–570. doi: 10.1001/jamapsychiatry.2017.0678
- Mintz, C. M., Hartz, S. M., Fisher, S. L., Ramsey, A. T., Geng, E. H., Grucza, R. A., and Bierut, L. J. (2021). A cascade of care for alcohol use disorder: Using 2015–2018 National Survey on Drug Use and Health data to identify gaps in care. *Alcoholism: Clinical and Experimental Research*, (November 2020), 1–11. doi: 10.1101/2020.10.30.20222695
- National Collaborating Centre for Mental Health (UK). (2011). *Alcohol-Use Disorders: Diagnosis, Assessment, and Management of Harmful Drinking and Alcohol Dependence (NICE Clinical Guidelines, No. 115)*. Leicester, UK.
- Norström, T., and Rossow, I. (2016). Alcohol consumption as a risk factor for suicidal behavior: A systematic review of associations at the individual and at the population level. *Archives of Suicide Research*, 20(4), 489–506. Taylor & Francis. doi: 10.1080/13811118.2016.1158678
- Oleski, J., Mota, N., Cox, B. J., and Sareen, J. (2010). Perceived need for care, help seeking, and perceived barriers to care for alcohol use disorders in a national sample. *Psychiatric Services*, 61(12), 1223–1231. doi: 10.1176/ps.2010.61.12.1223
- Olfson, M., Schoenbaum, M., and Goldman-Mellor, S. (2020). Risks of mortality following nonfatal intentional and unintentional opioid overdoses. *JAMA Psychiatry*, [epub ahead of print]. doi: 10.1001/jamapsychiatry.2020.1045
- Olfson, M., Wall, M., Wang, S., Crystal, S., Gerhard, T., and Blanco, C. (2017). Suicide following deliberate self-harm. *American Journal of Psychiatry*, 174(8), 765–774. doi: 10.1176/appi.ajp.2017.16111288
- Parkman, T., Neale, J., Day, E., and Drummond, C. (2017a). Qualitative exploration of why people repeatedly attend emergency departments for alcohol-related reasons. *BMC Health Services Research*, 17(1), 1–9. BMC Health Services Research. doi: 10.1186/s12913-017-2091-9
- Parkman, T., Neale, J., Day, E., and Drummond, C. (2017b). How do people who frequently attend emergency departments for alcohol-related reasons use, view, and experience specialist addiction services? *Substance Use & Misuse*, 52(11), 1460–1468. Taylor & Francis. doi: 10.1080/10826084.2017.1285314
- Passetti, L. L., Godley, M. D., and Kaminer, Y. (2016). Continuing care for adolescents in treatment for substance use disorders. *Child and Adolescent Psychiatric Clinics of North America*, 25(4), 669–684. doi: 10.1016/j.chc.2016.06.003
- Rockett, I. R. H., Putnam, S. L., Jia, H., and Smith, G. S. (2003). Assessing substance abuse

treatment need: A statewide hospital emergency department study. *Annals of Emergency Medicine*, 41(6), 802–813. doi: 10.1067/mem.2003.189

Roerecke, M., and Rehm, J. (2013). Alcohol use disorders and mortality: A systematic review and meta-analysis. *Addiction*, 108(9), 1562–1578. doi: 10.1111/add.12231

Roerecke, M., and Rehm, J. (2014). Cause-specific mortality risk in alcohol use disorder treatment patients: A systematic review and meta-analysis. *International Journal of Epidemiology*, 43(3), 906–919. doi: 10.1093/ije/dyu018

Roizen, J. (1997). Epidemiological issues in alcohol-related violence. *Recent Developments in Alcoholism*, v. 13: *Alcohol and Violence* (pp. 7–37). Boston, MA: Springer.

Savic, M., Best, D., Manning, V., and Lubman, D. I. (2017). Strategies to facilitate integrated care for people with alcohol and other drug problems: A systematic review. *Substance Abuse: Treatment, Prevention, and Policy*, 12(1), 1–12. Substance Abuse Treatment, Prevention, and Policy. doi: 10.1186/s13011-017-0104-7

Schmidt, C. S., Schulte, B., Seo, H., Kuhn, S., O'Donnell, A., Kriston, L., Verthein, U., et al. (2016). Meta-analysis on the effectiveness of alcohol screening with brief interventions for patients in emergency care settings. *Addiction*, 111(5), 783–794. Wiley Online Library.

Shmulewitz, D., Aharonovich, E., Witkiewitz, K., Anton, R. F., Kranzler, H. R., Scodes, J., Mann, K. F., et al. (2021). The World Health Organization risk drinking levels measure of alcohol consumption: Prevalence and health correlates in nationally representative surveys of U.S. adults, 2001–2002 and 2012–2013. *American Journal of Psychiatry*, (June). doi: 10.1176/appi.ajp.2020.20050610

Simioni, N., Rolland, B., and Cottencin, O. (2015). Interventions for increasing alcohol treatment utilization among patients with alcohol use disorders from emergency departments: A systematic review. *Journal of Substance Abuse Treatment*, 58, 6–15. doi: 10.1016/j.jsat.2015.06.003

Solomon, J., Vanga, N., Morgan, J. P., and Joseph, P. (1980). Emergency-room physicians' recognition of alcohol misuse. *Journal of Studies on Alcohol*, 41(5), 583–586. Alcohol Research Documentation, Inc. doi: 10.15288/jsa.1980.41.583

Spillane, S., Shiels, M. S., Best, A. F., Haozous, E. A., Withrow, D. R., Chen, Y., Berrington De González, A., et al. (2020). Trends in alcohol-induced deaths in the United States, 2000–2016. *JAMA Network Open*, 3(2), 1–15. doi: 10.1001/jamanetworkopen.2019.21451

Stanley, B., Brown, G. K., Brenner, L. A., Galfalvy, H. C., Currier, G. W., Knox, K. L., Chaudhury, S. R., et al. (2018). Comparison of the Safety Planning Intervention with follow-up vs usual care of suicidal patients treated in the emergency department. *JAMA Psychiatry*, 75(9), 894–900. doi: 10.1001/jamapsychiatry.2018.1776

Substance Abuse and Mental Health Services Administration. (2019). *Key substance use and mental health indicators in the US: Results from the 2016 National Survey on Drug Use and Health (HHS Publication No. PEP19-5068, NSDUH Series H-54)*. Rockville, MD. doi: 10.1016/j.drugalcdep.2016.10.042

Tanner-Smith, E. E., and Lipsey, M. W. (2015). Brief alcohol interventions for adolescents and young adults: A systematic review and meta-analysis. *Journal of Substance Abuse*



*Treatment*, 51, 1–18. doi: 10.1016/j.jsat.2014.09.001

- Wakeman, S. E., Rigotti, N. A., Chang, Y., Herman, G. E., Erwin, A., Regan, S., and Metlay, J. P. (2019). Effect of integrating substance use disorder treatment into primary care on inpatient and emergency department utilization. *Journal of General Internal Medicine*, 34(6), 871–877. doi: 10.1007/s11606-018-4807-x
- White, A. M., Castle, I. J. P., Hingson, R. W., and Powell, P. A. (2020). Using death certificates to explore changes in alcohol-related mortality in the United States, 1999 to 2017. *Alcoholism: Clinical and Experimental Research*, 44(1), 178–187. doi: 10.1111/acer.14239
- White, A. M., Slater, M. E., Ng, G., Hingson, R., and Breslow, R. (2018). Trends in alcohol-related emergency department visits in the United States: Results from the Nationwide Emergency Department Sample, 2006 to 2014. *Alcoholism: Clinical and Experimental Research*, 42(2), 352–359. doi: 10.1111/acer.13559
- Wiercigroch, D., Sheikh, H., and Hulme, J. (2020). A rapid access to addiction medicine clinic facilitates treatment of substance use disorder and reduces substance use. *Substance Abuse Treatment, Prevention, and Policy*, 15(1), 4. doi: 10.1186/s13011-019-0250-1
- Williams, E. C., Achtmeyer, C. E., Young, J. P., Berger, D., Curran, G., Bradley, K. A., Richards, J., et al. (2018). Barriers to and facilitators of alcohol use disorder pharmacotherapy in primary care: A qualitative study in five VA clinics. *Journal of General Internal Medicine*, 33(3), 258–267. doi: 10.1007/s11606-017-4202-z