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Predictors of self-harm emergency department visits in adolescents: A statewide longitudinal study

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Abstract

Objective.—This study investigated patient- and area-level characteristics associated with adolescent emergency department (ED) patients' risk of subsequent ED visits for self-harm.

Method.—Retrospective analysis of adolescent patients presenting to a California ED in 2010 (n=480,706) was conducted using statewide, all-payer, individually linkable administrative data. We examined associations between multiple predictors of interest (patient sociodemographic factors, prior ED utilization, and residential mobility; and area-level characteristics) and odds of a self-harm ED visit in 2010. Patients with any self-harm in 2010 were followed up over several years to assess predictors of recurrent self-harm.

Results.—Self-harm patients (n=5,539) were significantly more likely than control patients (n=16,617) to have prior histories of ED utilization, particularly for mental health problems, substance abuse, and injuries. Residential mobility also increased risk of self-harm, but racial/ethnic minority status and residence in a disadvantaged zipcode decreased risk. Five-year cumulative incidence of recurrent self-harm was 19.3%. Admission as an inpatient at index visit,

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Medicaid insurance, and prior ED utilization for psychiatric problems or injury all increased recurrent self-harm risk.

Conclusions.—A range of patient- and area-level characteristics observable in ED settings are associated with risk for subsequent self-harm among adolescents, suggesting new targets for intervention in this clinical context.

Keywords

Self-harm; adolescent; emergency department

1. INTRODUCTION

Adolescent nonfatal deliberate self-harm behavior is a significant and growing public health problem. In 2016, adolescents made more than 133,000 emergency department (ED) visits for deliberate self-harm, a rate 50% higher than just six years earlier [1]. Because the emergency department is the most common treatment setting for adolescents who sustain clinically serious self-harm injuries, the 2012 National Strategy for Suicide Prevention recommended that the ED be prioritized as a setting for research and intervention efforts [2]. One goal of this national agenda is to improve early identification of adolescent patients at elevated risk for self-harm, including recurrent self-harm, through the use of longitudinal, population-based ED data [3].

To date, however, most studies of adolescent ED self-harm have used cross-sectional visit-level data (e.g., [4–9]). Although this work has yielded important insights into sociodemographic and clinical correlates of self-harm visits, cross-sectional designs have limited utility for ED-based intervention planning. Only contemporaneous risk factors can be studied, and single vs. repeat patient visits cannot be distinguished. Our understanding of predictors of patient-level incident or recurrent ED self-harm comes from a small set of longitudinal studies, which report associations with baseline suicidality and depression symptoms, history of mental health service use, and familial socioeconomic disadvantage [10–15]. However, these studies are either small or used samples from single-payer pools, limiting their statistical power, generalizability and relevance for public health planning.

Prior work among adolescent self-harm patients, both cross-sectional and longitudinal, has focused largely on psychological and clinical risk factors. However, emerging research suggests that focusing exclusively on these factors may miss other important characteristics – including adolescents' histories of injury, illness, and residential mobility, as well as characteristics of their communities – that may also signal vulnerability for self-harm [16–21]. Associations between injury and self-harm, for example, may arise through pathways involving impulsiveness, externalizing psychopathology, and victimization [22–25]. Residential mobility may increase risk of self-harm via mechanisms involving stress (e.g., from changing schools or losing social support) as well as from the underlying causes of the move (e.g., parental loss of employment) [18,26]. At the community level, there are well-documented urban/rural and socioeconomic disparities in suicide death, which are thought to arise through differential incidence of psychological disorder, access to mental healthcare, or access to means [20,21,27]. Geographic disparities in *nonfatal* self-harm, however, remain

largely unexplored, although a better understanding of this phenomenon could shed light on the relative importance of the mechanisms underlying disparities in suicide [19]. Whether any of these more novel patient- and area-level characteristics independently predict adolescent ED self-harm over and above the traditional psychological and clinical risk factors is unknown.

Understanding which adolescents are at elevated risk for future self-harm is critical for ED clinicians seeking to identify and intervene with high-risk patients, and for health care systems seeking to appropriately allocate psychiatric and suicide prevention services. In the current study, we exploited statewide, individual-level emergency department data on adolescent patients in California to assess longitudinal associations between a broad array of predictors – patient sociodemographic and clinical characteristics, patient histories of ED utilization and residential mobility, and area-level economic disadvantage and urbanicity – and ED visits for self-harm. Because the demographic composition of the U.S. is increasingly like that of California [28], and the state's youth self-harm injury trends mirror those nationwide [29], its patient-level databases are a valuable resource for understanding adolescent self-harm. To provide comprehensive insight into their longitudinal patterns of self-harm risk, we examined associations between the study predictors of interest and both *any* ED visit for self-harm as well as *recurrent* visits for self-harm. We hypothesized that, in addition to the psychological and clinical factors of interest, adolescents' experiences of injury, illness, residential mobility, and community-level rurality and economic disadvantage would independently predict risk of self-harm.

2. METHODS

2.1 Data

This study was approved by the University of California, Merced Institutional Review Board. The California Office of Statewide Health Planning and Development provided nonpublic, anonymized, individual-level emergency department patient encounter data from all California-licensed ED facilities, excluding only those in federal (e.g., Veterans Administration) hospitals [30,31]. Data files from 2006 (the earliest year available) through 2015 were used. All data were screened by OSHPD's automated data entry and reporting software program (MIRCal), which returns data fields with error rates of ≥0.1% to the hospitals for correction [30]. Encounters that resulted in a hospital admission were included in the original data files; however, those missing patient age were excluded (<0.1%).

The final study dataset consisted of ED encounters for all adolescent patients aged 10 to 19 years with a unique identifier (encrypted social security number) and a California residential zip code in 2010 (64.7% of all records for this age group; Table S1). Unique identifiers were used to link all ED visits made by that patient over time, to any California ED facility; links were made both for several years prior (2006–2009) and subsequent (2010–2015) to the patient's index 2010 visit. Index visits were defined for self-harm patients as their first self-harm visit in 2010, and for other patients as their first ED visit for any condition in 2010. A total of 480,706 unique adolescent patients were available for analyses presented here.

We also obtained linked death record information from the California Department of Public Health Vital Records office, via a deterministic linkage process using patient social security number and birthdate [32]. This allowed us to calculate incidence of suicide and account for loss to follow-up from death through 2013, the most recent year available.

2.2 Study design

A case-control design was used to examine predictors of any self-harm ED visit in 2010. Cases comprised adolescent patients who presented in 2010 to an ED with an International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) [33] External Cause of Injury code (E-code) of E950.0–958, in any diagnostic position, indicating self-inflicted injury by poisoning, strangulation/suffocation, submersion, firearm, cutting or piercing, jumping, or other method [34]. ICD-9-CM E-codes E950–958 do not distinguish between events involving self-inflicted injury with intent to die and those involving no lethal intent (i.e., non-suicidal self-injury) [35,36]; therefore, our case definition captured both kinds of injury events. Controls comprised a randomly selected sample of adolescent patients who presented to an ED in 2010 for any reason other than self-harm, matched 3:1 to cases. Self-harm patients were more likely than other patients to be female (64.0% *vs.* 51.1%) and older (mean (SD) = 16.6 (2.0) *vs.* 15.5 (2.9) years). Accordingly, we matched cases and controls on sex and age (within 1 year), as well as on month of their index visits to control for seasonal effects [37].

A cohort design was used to examine predictors of recurrent self-harm ED visits among cases whose index self-harm visit was nonfatal. Follow-up began on the date following each case's index visit and ended on Sept. 30, 2015, to avoid injury diagnosis misclassification problems related to the mandatory transition from ICD-9-CM to ICD-10-CM coding on Oct. 1, 2015 [38]. Recurrent self-harm visits were defined identically to the index visit.

Cohort analyses also examined incidence of suicide death, defined as deaths with a primary International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10) code of X60 to X84, Y87.0, or U03 [39]. Follow-up for suicide ended on Dec. 31, 2013.

2.3 Risk factor measures

Patient- and area-level characteristics at index 2010 visit.—Patient age in years, sex, race/ethnicity (collapsed into White, Black, Hispanic, Asian/Pacific Islander, or other), and insurance type (private, Medicaid, self-pay, or other) were assessed at each patient's index visit and included as predictors in both case-control and cohort analyses. For self-harm patients, two additional patient-level characteristics – disposition (discharged home, admitted as inpatient, died, or other) and violence of the self-harm method used in the index injury [13,40] – were included as predictors in cohort analyses. Area-level characteristics assessed at the index visit included economic disadvantage and urbanicity of patients' residential zipcodes. Zipcode economic disadvantage was defined using a standardized composite of percent of families below poverty level, unemployment rate, and median household income (reverse-coded), based on 2010 estimates supplied by GeoLytics [41,42]. This continuous variable was collapsed into quartiles, with the first quartile corresponding to

the lowest level of disadvantage (mean percent families below poverty level [FPL]=4.0%, mean unemployment rate=5.4%, mean household income=$70,751) and the fourth quartile corresponding to highest level of disadvantage (mean FPL=21.4%, mean unemployment rate=26.8%, mean household income=$30,881). Zipcode urbanicity was defined using the U.S. Department of Agriculture's Rural-Urban Commuting Areas 2010 geographic taxonomy, Version 3.10 (collapsed into metropolitan, micropolitan, and small town/rural categories [43]).

Patients' prior emergency department utilization.—We constructed a variable totaling all ED visits each patient made for any reason in the four years prior to 2010 (2006–2009). In multivariate models, patients who made >20 visits (n=59 self-harm cases and 24 controls) were reclassified as having made 20 visits.

We then used ICD-9-CM E-codes and Clinical Classification Software (CCS) codes to ascertain patients' prior ED utilization for specific clinical conditions. CCS codes aggregate ICD-9-CM diagnoses into a smaller number of discrete, clinically meaningful categories [44]. Prior utilization variables were constructed for any mental health visit (CCS codes 650–659, 662, 663, or 670) and any self-harm visit (ICD-9-CM codes E950.0-E958), as well as for the mental health problems that most strongly predict self-harm: anxiety, mood, attention/conduct, and psychotic disorders (CCS codes 651, 657, 652, and 659) [45]. Utilization variables were also constructed for any substance use visit (CCS codes 660–661), any assault visit (ICD-9-CM codes E960.0-E969), any unintentional injury visit (ICD-9-CM codes E001.0–E030 and E800.0-E949), and any somatic complaint visit (all other CCS codes, with no E-code present).

Lastly, we constructed a crude measure of patient history of residential mobility. Patients observed at least once during 2006–2009 but who had only one recorded zipcode formed the reference group. "Residentially mobile" patients were those with more than one recorded zipcode during 2006–2009. Patients with no visit during 2006–2009 formed a third group.

2.4 Statistical Analyses

Case-control analyses used conditional logistic regression to examine predictors of making any self-harm ED visit in 2010. Each predictor was first entered independently in a bivariate model. We then ran partially adjusted models for each predictor that included adolescent race/ethnicity, insurance status, and total number of 2006–2009 ED visits as covariates. These characteristics likely confounded our associations of interest, as all three strongly predict patterns of incidence and treatment-seeking for self-harm behavior and other mental health problems [4,46,47] as well as being correlated with area-level factors and adolescent health [21,48]. Finally, we ran one fully adjusted model that included all predictor variables together, to identify which characteristics remained independently associated with self-harm. All models additionally controlled for age as a continuous variable, to account for any residual confounding by age.

For recurrence analyses, we first calculated cumulative incidence of any recurrent self-harm visit within 30 days, one year, and until the end of follow-up. We then modeled risk ratios estimating associations between each predictor and risk of any recurrent self-harm by end of

follow-up [49]. We first ran bivariate models in which each predictor was entered independently; analyses were then repeated adding controls for patient age, sex, race/ethnicity, insurance status, and number of 2006–2009 ED visits; finally, we ran a fully adjusted model that included all predictors together. All recurrence models included an offset term consisting of person-time observed for each patient during follow-up.

Lastly, we calculated cumulative incidence of suicide death by Dec. 31, 2013. Suicide deaths were rare and very few predictors were significantly associated with suicide risk; thus, no statistical models are presented for this outcome. All analyses were conducted using Stata 14.0 (StataCorp LP).

3. RESULTS

3.1 Sample characteristics

Of the 480,706 unique patients in our study data who presented to a California ED in 2010, a total of 5,539 received an E-code indicating self-harm injury. All self-harm patients were successfully matched to three controls. Most index self-harm injuries (96.9%) were non-violent; the most common E-codes among cases were for self-poisoning (59.3%) and cutting/piercing (25.0%). Among controls, the diagnostic codes most frequently present at index visit included sprain (8.6%) and abdominal pain (6.4%). Individual- and area-level characteristics assessed at index visit and during 2006–2009 for all study patients, as well as for self-harm patients and matched control patients, are shown in Table 1. The majority (57.2%) of self-harm patients, and half (49.8%) of control patients, had made at least 1 ED visit in 2006–2009. Only 8.5% of self-harm patients had a history of prior self-harm, suggesting that most index visits in 2010 were likely those adolescents' first ED encounters for self-harm.

3.2 Risk factors associated with any self-harm

Results from case-control analyses are shown in Table 2. Bivariate analyses indicated that self-harm patients were substantially less likely than matched controls to be of minority race/ethnicity and to self-pay. However, cases were more often Medicaid-insured, and had more frequently visited the ED during 2006–2009.

In partially adjusted models that controlled for patient age, race, insurance, and total visits during 2006–2009, large case/control group differences emerged with respect to patients' prior ED utilization for mental health- and injury-related problems. Self-harm patients were four times more likely than controls to have made any prior mental health ED visit during 2006–2009, with especially elevated odds of a prior visit for self-harm (OR_{adj}=9.51, 95% confidence interval [CI] 7.70, 11.76), mood disorder (OR_{adj}=6.79 [5.84, 7.89]), or psychotic disorder (OR_{adj}=7.62 [5.45, 10.66]). Cases also had three times greater odds of a prior visit for substance use, and 57% greater odds of a prior visit for assault injury. They were also more likely than controls to have a prior unintentional injury visit, but *less* likely to have prior somatic complaint visits. Self-harm patients had approximately 40% higher odds of being residentially mobile. Analyses of area-level indicators measured at index visit showed that self-harm patients were significantly less likely than controls to live in economically

disadvantaged zip codes; cases and controls did not differ, however, with respect to urbanicity.

In the fully adjusted model that included all predictors together, many of these associations were reduced in magnitude and some became non-significant. However, White race/ethnicity, history of residential mobility, total ED visit history, and history of a prior ED visit for assault and specific mental health problems – namely, self-harm, mood disorder, psychotic disorder, or substance use disorder – remained associated with increased odds of self-harm in 2010. Residence in an economically disadvantaged neighborhood remained associated with decreased odds of self-harm.

3.3 Risk factors associated with recurrent self-harm

A total of 5,529 self-harm patients had nonfatal index injuries and were included in recurrence analyses. Among these adolescents, cumulative incidence of any recurrent ED visit for self-harm was 2.4% (n=131) within 30 days, 10.7% (n=593) within one year, and 19.3% (n=1,065) by end of follow-up. The average number of recurrent self-harm visits through end of follow-up was 0.42 (range: 0–40); among those with any recurrent visit, the average was 2.16. More than half (52.9%) of recurrent visits were made to ED facilities different from those at the index visit.

Linkage with death records indicated that 42 patients died during follow-up through 2013; 14 of these deaths were suicides (cumulative incidence of 0.25%). Most (n=11) suicide deaths were among males; the average age at suicide death was 19.2 years.

Percentages of self-harm patients with any recurrent self-harm visit within 1 year and by end of follow-up, according to characteristics assessed at index visit and during 2006–2009, are shown in Table S2. Results from risk ratio models are shown in Table 3. Partially adjusted analyses indicated that risk of a recurrent self-harm visit by the end of follow-up was higher among younger self-harm patients, those with Medicaid insurance, and those with greater ED utilization during 2006–2009. Female sex was associated with increased risk of recurrence in bivariate models, but this association was reduced to marginal significance in the fully adjusted model. Self-harm patients from minority racial/ethnic groups, and those who self-paid at index visit, were less likely to present with recurrent self-harm.

Partially adjusted models showed that adolescents admitted to inpatient care at their index visit were nearly 30% more likely than those discharged home to recurrently self-harm (RR_{adj}=1.29 [1.16, 1.44]). In contrast, use of a violent method at index self-harm injury was not associated with recurrence. Adolescents with prior ED utilization for mental health problems faced particularly elevated risk for recurrent self-harm. Almost half (47.7%) of those with a prior self-harm visit returned to the ED for self-harm during follow-up, compared to 16.4% of those without such history (partially adjusted RR=2.03 [1.77, 2.33]). Adolescents with prior anxiety, mood, or psychotic disorder visits were also 37% to 93% more likely than their peers to engage in recurrent self-harm. Patient histories of substance use- or assault injury-related visits, however, were not associated with recurrence. Residence in the most economically disadvantaged zip code quartile was associated with reduced risk of recurrence.

In the fully adjusted model, associations between the predictors and self-harm recurrence were somewhat reduced in magnitude, and risk ratios for history of substance abuse and injuries became non-significant. Once again, adolescents' prior histories of self-harm, mood disorder, and psychotic disorder emerged as the strongest predictors of recurrent self-harm. Hospitalization at index visit and Medicaid insurance also remained strongly associated with increased risk of recurrence, while residence in an economically disadvantaged neighborhood was associated with reduced risk of recurrence.

4. DISCUSSION

Findings from this large, longitudinal study suggest that a wide range of characteristics detectable in emergency department settings predict subsequent self-harm among adolescent patients. The strongest associations we observed, for both any self-harm as well as repeated events, were with adolescents' prior ED utilization for mental health problems, especially diagnoses of self-harm, mood disorder and psychotic disorder. This is consistent with prior studies reporting that depressed mood, suicidality, and history of mental health service use predict future self-harm [6,11,12]. We also observed that overall ED utilization rates predicted increased risk of both any and repeat self-harm, again consistent with prior work [6].

We also identified several novel individual-level predictors of ED visits for self-harm. In particular, patient histories of assault injury, unintentional injury, and residential mobility were associated with any self-harm in 2010 (and with repeat self-harm in partially adjusted analyses), and admission to hospital at index visit was associated with substantially higher risk for repeat self-harm. Although past involvement in violence (either as victim or perpetrator) and family backgrounds that can involve frequent housing changes (e.g., foster care, divorced or military-employed parents, homelessness) have previously been reported among suicidal youths [23,26,45,50–52], our results show that patients with these characteristics could be easily identified in ED records and targeted for mental health evaluation and intervention. The implications of the hospital admission findings are less clear-cut. Hospitalization is clinically indicated for patients deemed at imminent risk of suicide and those with worse mental and physical health, whose elevated likelihood of recurrent self-harm is well-established [53]; thus, our results may simply reflect the greater level of psychological vulnerability of this patient group. Nevertheless, hospitalization itself could exacerbate some adolescents' vulnerability through processes involving stress, stigma, and isolation [53], a sobering possibility that warrants additional exploration.

Another important contribution of this study was its examination of area-level predictors. These revealed substantial *inverse* associations between residential socioeconomic disadvantage and risk of both any and recurrent ED self-harm (even after controlling for individual-level factors), but no association between urbanicity and self-harm. The finding that adolescents from more affluent areas were more likely to ever or recurrently self-harm contradicted our hypothesis, and is inconsistent with some prior research [21,54–57]. However, other work has found high rates of self-injury among affluent youths [58], attributed in part to dynamics involving excessive parental criticism and youth alienation. Intriguingly, we also found that presumably lower-income patients – those with Medicaid –

also had increased risk of self-harm. It is possible that affluent adolescents' self-harm behavior is largely NSSI, while that of disadvantaged adolescents reflects true suicide attempts; however, without nuanced clinical and family-level socioeconomic data, we could not assess this post-hoc hypothesis.

We found no difference in likelihood of ED self-harm for rural vs. urban adolescents, which is somewhat surprising given the scarcity of outpatient mental health providers in rural areas [59,60]. Suicide mortality rates among youths are elevated in rural areas [27,29], but geographic disparities in self-reported suicidal behavior are less consistent [19,61]. One interpretation of our finding is that serious self-harm injuries are equally likely to get emergency care regardless of geographic context; if so, this underscores the difference between populations of individuals self-reporting, receiving treatment for, and dying by self-harm.

Adolescents of Black, Hispanic, and Asian racial/ethnicity groups were significantly less likely than White adolescents to ever or recurrently self-harm, a finding consistent with some [4,24,40,62] although not all [4,8] previous studies. These differences warrant further investigation, particularly into cultural factors such as moral beliefs about suicide [63], academic norms [64], social contagion processes [65], and media depictions of self-harm [66] that may offer protective value in racial/ethnic subgroups.

The fact that nearly 60 percent of self-harm patients were seen in the ED prior to their index self-harm visit, and that 20 to 50 percent then experienced serious recurrent self-harm, underscores the ED's value as a potential intervention opportunity. Although universal suicidal ideation screening has been recommended for patients in all healthcare settings [67], many EDs have yet to implement screening, and many youths deny suicidal thoughts. Our findings suggest that promising psychiatric and social services indicated for adolescent patients presenting with self-harm [68–73] may have benefits if extended to those presenting with mental health problems, substance use, assault or unintentional injury, and a history of residential mobility – perhaps especially if they live in wealthier neighborhoods. Notably, none of the characteristics we examined (novel or traditional) had high specificity for predicting self-harm [74]; however, our results suggest they should be incorporated into the multifactorial risk prediction algorithms that are gaining traction as a method of identifying high-risk adolescents [75–77]. Although the ED has not been the focus of this work, our results suggest that it is a very common clinical context in which to encounter adolescents who subsequently self-harm.

This study had several limitations. First, we lacked longitudinal data on patient visits without a unique identifier, and cannot be sure that our results generalize to all California adolescents presenting to the ED, although visits with and without identifiers were relatively similar. Second, visits occurring out-of-state were unobservable. We think it unlikely, however, that this led to substantial bias in our results. Overall out-migration from California was low during this time period (0.2%; [78], and while some patients would have moved away for college, the associated loss-to-follow-up was likely minimal as the vast majority of college-bound students stay within the state [79,80]. Third, the comparison group in the case-control analyses comprised other ED patients, which likely biased the estimated

associations towards the null since ED patients are typically less healthy than the general population [81]. Lastly, our case definition captured both suicide attempts as well as nonsuicidal self-harm, which may have different etiologies and clinical courses [82]; moreover, ED-observed self-injuries represent a relatively severe subset of all such injuries. Study results may thus not be generalizable to youths who self-harm but do not seek ED care.

Methodological advantages of the study include its population-based design, its large and diverse patient population, its capacity to track patients longitudinally as they made visits to any ED in California (allowing us to identify risk factors observable *prior* to index self-harm events), follow-up periods of several years, and statistical controls for patients' prior ED utilization patterns. The analysis was also strengthened by its inclusion of a broad range of risk factors at multiple levels of analysis.

The findings document the importance of using longitudinal epidemiologic data to identify factors predicting adolescent ED visits for self-harm. Although a history of psychiatric problems emerged as the strongest risk factor for these serious self-injuries, other characteristics also played important roles. As rates of self-harm continue to rise among American adolescents, these findings should motivate future intervention research and improve targeting of ED-based prevention programs for vulnerable youths.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Characteristics assessed at index visit and during 2006–2009, according to patient group.

Characteristic	All patients (N=480,706)	Self-harm patients (N=5,539)	Age- and sex-matched control patients (N=16,617)
	n (%)	n (%)	n (%)
Patient characteristics			
Age in years, mean (SD)	15.5 (2.88)	16.6 (2.04)	16.4 (2.29)
10–14 years	169,055 (35.2	920 (16.6)	3,731 (22.5)
15–19 years	311,651 (64.8)	4,619 (83.4)	12,886 (77.6)
Sex			
Female	245,735 (51.1)	3,545 (64.0)	10,635 (64.0)
Male	234,971 (48.9)	1,994 (36.0)	5,982 (36.0)
Race/ethnicity			
White	164,808 (34.3)	2,407 (43.5)	5,886 (34.4)
Black	59,282 (12.3)	607 (11.0)	2,041 (12.3)
Hispanic	202,479 (42.1)	1,908 (34.5)	6,835 (41.1)
Asian/pacific islander	19,347 (4.0)	200 (3.6)	654 (3.9)
Other	34,790 (7.2)	417 (7.5)	1,201 (7.2)
Insurance type			
Private	202,074 (42.0)	2,351 (42.4)	7,119 (42.8)
Medicaid	199,791 (41.6)	2,404 (43.3)	6,610 (39.8)
Self-pay	62,112 (12.9)	590 (10.7)	2,274 (13.7)
Other	16,694 (3.5)	194 (3.5)	612 (3.7)
Disposition			
Discharged home	443,939 (92.4)	2,493 (45.0)	15,439 (92.9)
Admitted as inpatient	28,565 (5.9)	2,853 (51.5)	917 (5.5)
Other	8,131 (1.7)	187 (3.4)	257 (1.6)
Died during visit[a]	71 (0.01)	- (<0.5)	-- (<0.1)
Violent self-injury method			
Non-violent	480,534 (1.1)	5,367 (96.9)	*n.a.*
Violent	172 (0.0)	172 (3.1)	*n.a.*
Residential mobility, 2006–2009			
1 zip code recorded	203,387 (42.3)	2,307 (41.7)	6,799 (40.9)
>1 zip code recorded	45,186 (9.4)	85(15.5)	1,483 (8.9)
No visit recorded	232,133 (48.3)	2,37 (42.8)	8,335 (50.2)
Area-level characteristics			
Urbanicity of patient zip			
Metropolitan	441,098 (91.8)	5,043 (91.1)	15,274 (91.9)
Micropolitan	27,715 (5.8)	359 (6.5)	938 (5.6)
Small town/rural	11,759 (2.5)	132 (2.4)	402 (2.4)
Economic disadvantage of patient zip			
Quartile 1 (lowest disadvantage)	119,291 (24.8)	1,564 (28.2)	4,127 (24.8)

Characteristic	All patients (N=480,706)	Self-harm patients (N=5,539)	Age- and sex-matched control patients (N=16,617)
	n (%)	n (%)	n (%)
Quartile 2	118,191 (24.6)	1,374 (24.8)	4,087 (24.6)
Quartile 3	118,492 (24.7)	1,357 (24.5)	4,107 (24.7)
Quartile 4 (highest disadvantage)	118,650 (24.7)	1,164 (21.0)	4,073 (24.5)
Patient ED utilization, 2006–2009			
Total visits, mean (SD)	1.49 (2.62)	2.20 (4.23)	1.45 (2.72)
Mental health visits:			
Any mental health visit	28,546 (5.9)	1,198 (21.6)	1,035 (6.2)
Any self-harm visit	3,807 (0.8)	471 (8.5)	134 (0.8)
Any anxiety disorder visit	8,858 (1.8)	438 (7.9)	328 (2.0)
Any mood disorder visit	8,622 (1.8)	739 (13.3)	340 (2.1)
Any attention/cd visit	4,997 (1.0)	235 (4.2)	151 (0.9)
Any psychotic disorder visit	1,599 (0.3)	172 (3.1)	49 (0.3)
Any substance use visit	9,886 (2.1)	43 (7.9)	364 (2.2)
Any assault injury visit	11,676 (2.4)	279 (5.0)	406 (2.4)
Any unintentional injury visit	132,260 (27.5)	1,926 (34.8)	4,252 (25.6)
Any somatic complaint visit	188,315 (39.2)	2,136 (38.6)	6,333 (38.1)

Due to missing values for some patients, percentages do not always sum to 100.0%.

[a] Exact counts and percentages suppressed to maintain patient privacy.

Table 2.

Predictors of any self-harm injury ED visit during 2010.

	Bivariate models[a] OR (95% CI)	Partially adjusted models[b] OR (95% CI)	Fully adjusted model[c] OR (95% CI)
Covariates			
Race/ethnicity (ref: white)			
Black	**0.72 (0.65, 0.80)**	*n.a.*	**0.76 (0.68, 0.86)**
Hispanic	**0.70 (0.65, 0.75)**	*n.a.*	**0.78 (0.72, 0.84)**
Asian/Pacific Islander	**0.78 (0.66, 0.92)**	*n.a.*	0.89 (0.74, 1.06)
Other	**0.86 (0.76, 0.98)**	*n.a.*	0.90 (0.78, 1.02)
Insurance type (ref: private)			
Medicaid	**1.09 (1.02, 1.17)**	*n.a.*	1.08 (1.00, 1.16)
Self-pay	**0.73 (0.65, 0.81)**	*n.a.*	**0.77 (0.68, 0.86)**
Other	0.94 (0.80, 1.12)	*n.a.*	0.95 (0.79, 1.14)
Total ED visits, 2006–2006	**1.08 (1.07, 1.09)**	*n.a.*	**1.04 (1.00, 1.08)**
Patient characteristics			
Residential mobility (ref: 1 zip code recorded)			
>1 zip code recorded	**1.72 (1.56, 1.89)**	**1.41 (1.26, 1.57)**	**1.22 (1.07, 1.38)**
No visit recorded	**0.84 (0.78, 0.89)**	0.96 (0.89, 1.03)	1.05 (0.96, 1.16)
Area-level characteristics			
Urbanicity of zip (ref: metropolitan)			
Micropolitan	**1.16 (1.02, 1.32)**	0.97 (0.85, 1.11)	1.10 (0.95, 1.27)
Small town/rural	0.99 (0.81, 1.21)	0.85 (0.69, 1.04)	0.96 (0.77, 1.19)
Economic disadvantage of zip (ref: Q1)			
Quartile 2	**0.89 (0.81, 0.96)**	**0.92 (0.84, 0.99)**	0.91 (0.83, 1.00)
Quartile 3	**0.87 (0.80, 0.95)**	**0.89 (0.82, 0.98)**	**0.90 (0.82, 0.99)**
Quartile 4 (highest disadvantage)	**0.75 (0.69, 0.82)**	**0.80 (0.72, 0.87)**	**0.82 (0.74, 0.90)**
Patient ED utilization, 2006–2009			
Mental health visits:			
Any mental health visit	**4.27 (3.89, 4.68)**	**3.99 (3.58, 4.44)**	**1.78 (1.51, 2.11)**
Any self-harm visit	**11.64 (9.52, 14.24)**	**9.51 (7.70, 11.76)**	**3.60 (2.82, 4.59)**
Any anxiety disorder visit	**4.36 (3.75, 5.07)**	**3.22 (2.74, 3.79)**	1.05 (0.85, 1.30)
Any mood disorder visit	**7.42 (6.47, 8.51)**	**6.79 (5.84, 7.89)**	**2.25 (1.84, 2.75)**
Any attention/conduct disorder visit	**4.91 (3.98, 6.05)**	**3.37 (2.69, 4.22)**	1.25 (0.95, 1.63)
Any psychotic disorder visit	**10.71 (7.78, 14.75)**	**7.62 (5.45, 10.66)**	**2.45 (1.68, 3.58)**
Any substance use visit	**3.9 (3.44, 4.62)**	**2.99 (2.55, 3.50)**	**1.68 (1.40, 2.02)**
Any assault injury visit	**2.14 (1.83, 2.50)**	**1.57 (1.33, 1.86)**	**1.43 (1.18, 1.73)**
Any unintentional injury visit	**1.55 (1.45, 1.66)**	**1.28 (1.19, 1.39)**	0.98 (0.87, 1.09)
Any somatic complaint visit	1.02 (0.96, 1.09)	**0.74 (0.72, 0.77)**	**0.90 (0.86, 0.94)**

Boldface font indicates statistical significance ($p<0.05$). All models were estimated using conditional logistic regression (matching factors: sex, age, and month of index visit) and additionally controlled for age as a continuous variable.

[a] Bivariate models controlled for patient age.

[b] Partially adjusted models controlled for patient age, race/ethnicity, insurance status at index visit, and total number of ED visits observed during 2006–2009. Coefficients for these covariates are not shown in the table as their values changed slightly with each model.

[c] Fully adjusted model included patient age and all variables in the Table.

Table 3.

Predictors of any recurrent self-harm visit through Sept. 30, 2015, among 5,529 patients with any self-harm visit in 2010.

	Bivariate models		Partially adjusted models[a]		Fully adjusted model[b]
	RR	95% CI	RR	95% CI	RR
Covariates					
Age in years	**0.96 (0.94, 0.99)**		*n.a.*		**0.94 (0.91, 0.96)**
Female sex (ref: male)	**1.21 (1.07, 1.35)**		*n.a.*		1.09 (0.97, 1.23)
Race/ethnicity (ref: white)					
Black	**0.81 (0.67, 0.96)**		*n.a.*		**0.80 (0.67, 0.95)**
Hispanic	**0.67 (0.59, 0.76)**		*n.a.*		**0.71 (0.62, 0.81)**
Asian/Pacific Islander	**0.41 (0.26, 0.63)**		*n.a.*		**0.45 (0.30, 0.70)**
Other	**0.73 (0.58, 0.91)**		*n.a.*		**0.76 (0.60, 0.95)**
Insurance type (ref: private)					
Medicaid	**1.31 (1.17, 1.47)**		*n.a.*		**1.19 (1.05, 1.34)**
Self-pay	**0.62 (0.49, 0.80)**		*n.a.*		**0.70 (0.55, 0.89)**
Other	1.06 (0.78, 1.44)		*n.a.*		1.03 (0.77, 1.39)
Total ED visits, 2006–2009	**1.08 (1.08, 1.09)**		*n.a.*		**1.03 (1.01, 1.05)**
Patient characteristics					
Disposition (ref: discharged home)					
Admitted as inpatient	**1.24 (1.11, 1.38)**		**1.29 (1.16, 1.44)**		**1.26 (1.13, 1.41)**
Other	1.00 (0.72, 1.39)		1.02 (0.74, 1.41)		1.04 (0.76, 1.43)
Violent self-injury method (ref: non-violent)					
Violent	0.81 (0.57, 1.16)		0.79 (0.55, 1.11)		0.72 (0.51, 1.02)
Residential mobility (ref: 1 zip code recorded)					
>1 zip code recorded	**1.51 (1.33, 1.72)**		1.07 (0.92, 1.25)		0.99 (0.85, 1.16)
No visit recorded	**0.68 (0.59, 0.77)**		**0.84 (0.73, 0.96)**		0.99 (0.84, 1.18)
Area-level characteristics					
Urbanicity of zip (ref: metropolitan)					
Micropolitan	1.10 (0.89, 1.35)		0.92 (0.74, 1.13)		1.07 (0.87, 1.31)
Small town/rural	**1.36 (1.01, 1.82)**		1.07 (0.80, 1.43)		1.28 (0.95, 1.73)
Economic disadvantage of zip (ref: Q1)					
Quartile 2	0.93 (0.81, 1.08)		0.96 (0.83, 1.10)		0.96 (0.83, 1.10)
Quartile 3	0.89 (0.77, 1.03)		0.88 (0.76, 1.01)		0.90 (0.78, 1.03)
Quartile 4 (highest disadvantage)	**0.75 (0.63, 0.88)**		**0.72 (0.61, 0.85)**		**0.74 (0.63, 0.87)**
Patient ED utilization, 2006–2009					
Mental health visits:					
Any mental health visit	**2.32 (2.08, 2.57)**		**1.76 (1.56, 1.99)**		1.17 (0.96, 1.43)
Any self-harm visit	**2.81 (2.51, 3.15)**		**2.03 (1.77, 2.33)**		**1.48 (1.26, 1.75)**
Any anxiety disorder visit	**2.47 (2.19, 3.00)**		**1.63 (1.39, 1.90)**		**1.18 (1.01, 1.39)**
Any mood disorder visit	**2.60 (2.33, 2.89)**		**1.93 (1.69, 2.20)**		**1.30 (1.07, 1.58)**
Any attention/CD visit	**2.37 (1.01, 2.77)**		**1.37 (1.15, 1.63)**		1.08 (0.91, 1.28)

	Bivariate models		Partially adjusted models[a]		Fully adjusted model[b]
	RR	95% CI	RR	95% CI	RR
Any psychotic disorder visit	**3.05 (2.64, 3.52)**		**1.78 (1.48, 2.13)**		**1.39 (1.15, 1.67)**
Any substance use visit	**1.70 (1.46, 1.97)**		1.16 (0.98, 1.36)		0.97 (0.83, 1.13)
Any assault injury visit	**1.52 (1.25, 1.83)**		1.02 (0.84, 1.24)		1.01 (0.83, 1.21)
Any unintentional injury visit	**1.82 (1.63, 2.02)**		**1.32 (1.17, 1.50)**		1.14 (0.97, 1.34)
Any somatic complaint visit	**1.06 (1.05, 1.07)**		**0.93 (0.91, 0.96)**		0.99 (0.97, 1.01)

Boldface font indicates statistical significance ($p<0.05$). Risk ratios calculated according to Zou 2004 [49].

[a]Bivariate models controlled for patient age.

[b]Partially adjusted models controlled for patient age, race/ethnicity, insurance status at index visit, and total number of ED visits observed during 2006–2009. Coefficients for these covariates are not shown in the table as their values changed with each model.

[c]Fully adjusted model included all variables in the Table.