

UC Merced

UC Merced Previously Published Works

Title

Emergency Department Use and Inpatient Admissions and Costs Among Adolescents With Deliberate Self-Harm: A Five-Year Follow-Up Study

Permalink

<https://escholarship.org/uc/item/3b33g9tp>

Journal

Psychiatric Services, 71(2)

ISSN

1075-2730

Authors

Goldman-Mellor, Sidra
Phillips, Dwena
Brown, Paul
[et al.](#)

Publication Date

2020-02-01

DOI

10.1176/appi.ps.201900153

Peer reviewed



Published in final edited form as:

Psychiatr Serv. 2020 February 01; 71(2): 136–143. doi:10.1176/appi.ps.201900153.

Emergency department utilization, inpatient admissions, and inpatient costs among adolescent deliberate self-harm patients: A five-year follow-up study

Sidra Goldman-Mellor, Ph.D.*,

Department of Public Health; School of Social Sciences, Humanities, and Arts; University of California, Merced; Merced CA 95343, USA.

Dwena Phillips,

Department of Public Health; School of Social Sciences, Humanities, and Arts; University of California, Merced; Merced CA 95343, USA.

Paul Brown, Ph.D.,

Department of Public Health; School of Social Sciences, Humanities, and Arts; University of California, Merced; Merced CA 95343, USA.

Paul Gruenewald, Ph.D.,

Prevention Research Center, Pacific Institute for Research and Evaluation; Oakland, CA 94612 USA.

Magdalena Cerdá, Dr.P.H.,

Department of Population Health, New York University; New York, NY 10016.

Deborah Wiebe, Ph.D.

Department of Psychology; School of Social Sciences, Humanities, and Arts; University of California, Merced; Merced CA 95343, USA.

Abstract

Objective—Adolescent self-harm rates have risen substantially in the U.S., yet health and social outcomes among contemporary self-harming youths are infrequently tracked and remain poorly understood. This study investigated long-term health service utilization (emergency department [ED] visits and inpatient admissions) and inpatient costs among a recent cohort of adolescent deliberate self-harm patients.

Methods—This retrospective cohort study used statewide, all-payer, longitudinally-linked patient discharge data from California, USA. All CA residents aged 10–19 years presenting to EDs in 2010 with deliberate self-harm (n=5,396) were compared with two control groups: A random sample of adolescent patients with other complaints, matched on sex, age, residential ZIP code, and month of index visit (general control patients; n=14,921), and matched patients with psychiatric complaints but no self-harm (psychiatric controls; n=15,835). Study outcomes included

*Corresponding author: Sidra Goldman-Mellor, Ph.D., Department of Public Health, School of Social Sciences, Humanities, and Arts, University of California, Merced; Merced, CA 95343, USA, (209) 228-2498, sgoldman-mellor@ucmerced.edu.

Conflicts of interest: The authors report no potential conflicts of interest.

five-year rates of subsequent ED visits, inpatient admissions, and inpatient costs, both overall and for psychiatric and non-psychiatric complaints separately.

Results—Self-harm patients' rates of ED utilization, inpatient admissions, and inpatient costs were significantly higher than those of general control patients (by 39%, 81%, and 21%, respectively), controlling for confounding demographic and utilization characteristics. Associations mostly persisted, though smaller in magnitude, in comparisons with psychiatric control patients. Both psychiatric and non-psychiatric complaints contributed to self-harming adolescents' excess health service utilization and costs.

Conclusion—Adolescent deliberate self-harm is associated with long-lasting and costly patterns of health service utilization, often but not exclusively for psychiatric complaints. Future research should investigate the pathways underlying these associations, and incorporate service utilization as a key patient outcome.

INTRODUCTION

Nonfatal deliberate self-harm has emerged as a significant public health problem in the U.S., and is now the second leading cause of violence-related injury among 10- to 19-year-olds.¹ Emergency departments (EDs), where most seriously injured adolescent self-harm patients seek care, are at the front line for triaging these young patients and linking them with social and psychological services. Such services typically focus on reducing their risk for subsequent suicidal behavior (e.g.,^{2,3}). A small but growing literature also reports, however, that adolescent deliberate self-harm – especially suicide attempt, as distinguished from non-suicidal self-injurious behavior – is associated with other adverse mental health, physical health, and economic outcomes over the lifecourse, suggesting that self-harming adolescents may have broader health-related needs that currently receive little attention.^{4–8}

One approach to understanding these health needs, and to informing the design and focus of future intervention programs, is to examine self-harming youths' patterns of health service utilization. Service utilization is a key indicator of need for medical care, propensity to seek care, and barriers to receipt of care, and is frequently used as a metric for guiding resource allocation and developing interventions.^{9–11} At the system level, excess health service utilization contributes to strained provider resources and financial burden.¹² It also has implications for young people's educational attainment, labor market success, and financial independence during the critical transition to adulthood, because obtaining frequent medical care impedes youths' ability to attend school and work and can involve costly medical expenditures.^{13–17} To date, however, studies of health service utilization, and associated costs, among self-harming youths remain scarce.

Why might self-harming adolescents have higher rates of health care utilization and costs when compared to their peers? Perhaps most obviously, deliberate self-harm is typically accompanied by serious psychological problems (including a confluence of internalizing psychopathology, externalizing psychopathology, and impaired executive functioning)^{18–21} and family dysfunction,²² factors that independently increase risk of poor health outcomes, poor adherence to medical treatments, and increased health care utilization.^{4,23–27} However, associations between self-harm and subsequent self-reported health care utilization appear to

persist even after controlling for psychiatric diagnoses and family-level characteristics.^{5,7} Other potential explanations include self-harming adolescents' disproportionate risk of receiving ineffective outpatient care,^{27–30} as well as self-reinforcing cycles wherein an adolescent's history of self-harm (especially if resulting in hospitalization) drives caregivers and ED clinicians to interpret new health crises as serious and to preferentially recommend emergency treatment and/or admission.³¹ Such processes could result in higher rates of hospital-based healthcare utilization, an outcome that is particularly important to understand because it reflects the costliest and most medically severe component of healthcare.³²

To expand the limited evidence base on the population-level health care burden associated with adolescent self-harm, the current study used contemporary data from California, a large U.S. state with considerable demographic heterogeneity,³³ to investigate emergency department utilization, inpatient admissions, and inpatient costs among adolescent patients presenting to an ED with a diagnosis of deliberate self-harm (with or without intent to die). Because the design of future intervention programs depends on the nature of adolescents' health needs, the study also examined the respective contributions of psychiatric vs. non-psychiatric complaints to patterns of utilization and inpatient costs.

METHODS

Data

This study was approved by the University of California, Merced and California Department of Public Health Institutional Review Boards. The California Office of Statewide Health Planning and Development provided non-public, de-identified individual-level ED and inpatient admission patient encounter data from all California-licensed hospital facilities, excluding only those in federal hospitals, for years 2006–2015.^{29,30}

The study sample consisted of all adolescents aged 10 to 19 years who had an ED encounter in 2010 that included a unique identifier (encrypted social security number) and a California residential ZIP code.³⁴ To construct the cohort, each patient's unique identifier was used to link all ED and inpatient visits made subsequent to his or her index 2010 visit, to any California hospital facility, for the years 2010–2015. Links were also made to patients' prior ED visits, for the years 2006–2009.

Study groups

Deliberate self-harm patients were defined as those who presented in 2010 to any ED with an International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)³¹ 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.³² ICD-9-CM E-codes E950–958 do not distinguish between events involving self-inflicted injury with intent to die and those involving no intent to die (i.e., non-suicidal self-injury);^{33,34} therefore, this case definition captured both true suicide attempts as well as self-harm injuries with no suicidal intent.

The main comparison group (hereafter referred to as general control patients) comprised a randomly selected sample of adolescent patients who presented to any ED in 2010 for any

reason other than self-harm, matched 3:1 to self-harm patients. Matching factors comprised patient sex, age (within one year), residential ZIP code, and month of the index visit, to control for basic sociodemographic characteristics and seasonality. At least one matched general control from the same ZIP code was identified for 94.0% of self-harm patients. Where no exact ZIP code match was available, controls were sought from adjacent ZIP codes most closely matching that of the self-harm patient in terms of absolute proportional differences in population density and median income (adjacencies defined by queen's contiguity; population and income differences equally weighted). This procedure identified general controls for an additional 3.6% of self-harm patients.

To assess whether deliberate self-harm patients experienced study outcomes at a higher rate than patients with other mental health problems, we also identified a secondary comparison group, comprising adolescent ED patients who ever presented in 2010 with a principal diagnosis code indicating mental disorder, but *not* with deliberate self-harm. These psychiatric control patients were matched 3:1 to self-harm patients on sex, age, and month of index visit. Clinical Classification Software (CCS) codes, which aggregate ICD-9-CM diagnoses into a smaller number of discrete, clinically meaningful categories,³⁵ were used to identify mental disorder visits (codes 650–659, 662–663, and 670, comprising diagnoses for anxiety, mood, behavioral, personality, and psychotic disorders). Patients with suicidal ideation could be included in the psychiatric control group.

Index visits were defined for self-harm patients as their first self-harm visit in 2010, for general control patients as their first ED visit for any condition in 2010, and for psychiatric control patients as their first qualifying mental disorder visit in 2010. Patients who died at their index visit were excluded.

Outcome variables

Study follow-up for each patient began on the day after his or her index ED visit in 2010, and ended Sept. 30, 2015, to avoid potential reason-for-visit misclassification problems related to the mandatory transition from ICD-9-CM to ICD-10-CM coding on Oct. 1, 2015. Three primary study outcomes were examined. *Emergency department utilization* was defined as the patient's total number of ED visits during follow-up. *Inpatient admissions* was defined as the total number of times the patient was hospitalized overnight during follow-up, regardless of length of stay. All hospital facilities (community, psychiatric, etc.) and admission types (planned and unplanned, including admissions resulting from an ED visit) were included in this count. To determine whether psychiatric complaints accounted for any excess utilization among self-harming adolescents, each ED and inpatient visit was identified as psychiatric or non-psychiatric, with psychiatric visits defined as those with a primary diagnosis of anxiety, mood, behavioral, personality, or psychotic disorder (CCS codes 650–659, 662, 663, or 670). This information was used to create psychiatric and non-psychiatric versions of the ED utilization and inpatient admissions outcome variables.

Lastly, *total inpatient costs* were estimated using annually-determined Medicare Severity Diagnosis-Related Group (MS-DRG) payment rates associated with the principal ICD-9-CM diagnosis code at each hospitalization, summed over follow-up. Medicare per-discharge base payment rates and MS-DRG relative weights were obtained from the Centers for Medicare

and Medicaid Services website.³⁶ Using Medicare cost estimates for each visit allowed for standardizing the amount that different hospitals charge for the same reason-for-visit, which may vary considerably based on the facility's geographic location, contractual agreements with insurance companies, and other factors. Cost data were not available for ED visits, so this outcome underestimates study patients' costs associated with hospital-based care.

Covariates

Patient race/ethnicity (White, Black, Hispanic, Asian/Pacific Islander, other), payer type (private, Medicaid, self-pay, other), and disposition (discharged home, admitted as inpatient, other) were assessed at each patient's index visit. Controlling for disposition accounted for both severity of the patient's medical/psychological condition and the possibility that an index hospitalization may result in greater likelihood of ED visit or admission in the future.³⁴ To account for baseline group differences in health status and propensity to obtain care from the ED, several utilization history variables based on patients' linked ED records from 2006–2009 were constructed: (1) Total number of prior ED visits, (2) any prior visit for a mental health problem, including deliberate self-harm (CCS codes 650–659, 662, 663, or 670, in any diagnostic position), and (3) any prior visit for substance use (CCS codes 660–661, in any diagnostic position).³⁴

Statistical analyses

Descriptive statistics were calculated for all variables, and characteristics were compared between self-harm patients and control patients. Because all service utilization outcomes were over-dispersed count variables, negative binomial regression (the Stata command *nbg*) was used to estimate incidence rate ratios (IRRs)³⁷ comparing self-harm to matched general control patients and then, separately, to matched psychiatric control patients. AIC fit indices, and the statistically significant dispersion parameters, confirmed that negative binomial models were a better fit for the data than Poisson models. For these outcomes, all study patients were included.

For inpatient costs, analyses were restricted to patients who had any inpatient admission during follow-up, as patients without an inpatient admission were not at risk for this outcome. A generalized linear model with a gamma distribution and logarithmic transformation was used for this outcome,^{38,39} with coefficients interpreted as the percent change in inpatient costs associated with being in the self-harm group.

Patient characteristics assessed at index visit, and patient history of ED utilization during 2006–2009 (total visits, any visit for mental health, and any visit for substance use) were included as covariates in each regression model. All models used robust standard errors to account for the matched cohort design and repeated measures data^{40,41} and included an offset term defined for each patient as (30th September 2015 - patient's index visit date) to account for differences in follow-up time. Statistical analyses were conducted using Stata 14.0 (StataCorp LP).

RESULTS

Sample characteristics

Of the 481,915 unique patients in the study dataset who presented to a California ED in 2010, a total of 5,533 received an E-code indicating deliberate self-harm injury. Of these self-harm patients, 5,396 (97.6%) were matched to at least one general control patient (total general control patients=14,921) and 5,284 (95.5%) were matched to at least one psychiatric control patient (total psychiatric control patients=15,835). The most common E-codes among self-harm patients were for self-poisoning (n=3,210; 60%) and cutting/piercing (n=1,349; 25%) injuries. The diagnostic codes most frequently present among general control patients at index visit were sprains/strains (n=1,097; 7.4%), and superficial injury (n=945; 6.3%); among psychiatric control patients, the most frequent diagnostic codes were anxiety disorder (n=5,316; 33.6%) and mood disorder (n=4,270; 27.0%). Demographic characteristics assessed at patients' index visits, as well as patient histories of ED utilization between 2006 and 2009, are shown in Table 1.

Emergency department utilization

Deliberate self-harm patients made an average of 7.2 ± 12.1 ED visits during the follow-up period, compared to 4.3 ± 7.0 visits among general control patients and 6.6 ± 10.8 among psychiatric control patients.

In negative binomial regression models controlling for sociodemographic characteristics and histories of ED utilization, rates of overall ED utilization were approximately 40% higher among self-harm vs. general control patients (Table 2). The relative magnitude of the two groups' differences in ED visit rates was greater for psychiatric visits (IRR=3.62, 95% CI=3.14, 4.16) than for non-psychiatric visits (IRR=1.27, 95% CI=1.20, 1.33). However, because both patient groups presented to the ED much more frequently for non-psychiatric reasons than for psychiatric reasons, the excess burden of ED utilization associated with deliberate self-harm was greater for non-psychiatric visits than for psychiatric visits.

Rates of overall ED utilization did not significantly differ between self-harm vs. psychiatric control patients, and self-harm patients' ED utilization rate for psychiatric complaints was slightly lower (Table 3). Self-harm patients' rate of ED visits for non-psychiatric complaints, however, was 8% higher compared to that of psychiatric control patients (IRR=1.08, 95% CI=1.03, 1.14). Full model results for both comparisons, with covariate estimates and dispersion parameters, are provided in the Online Supplement.

Inpatient admissions

Half (50.2%; n=2,711) of deliberate self-harm patients, 25% (n=4,432) of general control patients, and 43% (n=6,802) of psychiatric control patients had any inpatient admission during follow-up. Self-harm patients averaged 1.7 ± 3.9 inpatient admissions during follow-up, compared to 0.6 ± 1.8 among general control patients and 1.3 ± 3.1 among psychiatric control patients.

In adjusted negative binomial regression models, rates of overall inpatient admission were approximately 80% higher among deliberate self-harm vs. general control patients (Table 2). After separating admissions into those for psychiatric vs. non-psychiatric reasons, only the self-harm group's psychiatric admission rates were substantially higher than general control patients' (IRR=5.55, 95% CI=4.64, 6.63). Rates of all types of inpatient admissions were significantly higher (12% to 17%) among self-harm patients when compared to psychiatric control patients (Table 3). Full model results are shown in the Supplement.

Inpatient costs

Among hospitalized patients, inpatient costs accrued by deliberate self-harm patients were higher relative to those among general control patients in each year of follow-up, and to those among psychiatric control patients in most years (Figure 1). Average total accrued inpatient costs were \$16,571 for self-harm patients vs. \$9,976 for general controls, a 21% difference after covariate adjustment (Table 2). However, this excess cost burden was driven by psychiatric admissions: Self-harming adolescents' psychiatric inpatient costs were four times those of general controls, but their costs for non-psychiatric admissions were significantly lower.

Total and psychiatric inpatient costs were only marginally higher among self-harm patients vs. psychiatric control patients, but their inpatient costs for non-psychiatric complaints were 11% higher, a significant difference (Table 3).

DISCUSSION

This is the first U.S. population-based study to examine objective measures of long-term health service utilization and inpatient cost patterns among adolescents who presented to the ED for deliberate self-harm. Results indicate that adolescent ED patients presenting with deliberate self-harm have substantially higher rates of subsequent ED utilization, inpatient admissions, and inpatient costs over 5 years of follow-up when compared to patients who present with other complaints. Many of these differences persisted, albeit reduced in magnitude, when comparing self-harm patients to patients with other mental health problems, suggesting that deliberate self-harm confers a certain amount of unique vulnerability.

Psychiatric problems were involved in most of self-harming adolescents' excess inpatient admissions and associated costs. Both psychiatric and non-psychiatric complaints contributed, however, to their excess ED utilization – indeed, non-psychiatric complaints were the primary diagnoses for approximately 84% of their subsequent ED visits. These findings indicate the need for greater clinical and public health attention to the full spectrum of self-harming youths' health-related needs, including both somatic and psychiatric problems.

This work builds on previous studies showing, variously, that deliberate self-harm is associated with higher rates of *self-reported* ED utilization and psychiatric hospitalization,^{5,7} poor physical health,^{5,6,8} poor mental health,^{5,42,43} poor social and economic outcomes,^{5,42,44} and excess mortality.^{45–47} Many of these studies relied on non-U.S. samples and/or

cohorts born in the 1970s, whose experiences (particularly with healthcare systems) may not be generalizable to current U.S. youths. The current study expands this literature by demonstrating, in a contemporary and diverse population-based U.S. sample, that adolescent self-harm is also associated with objectively-measured healthcare utilization and associated costs – even after controlling for multiple confounding variables, including prior ED utilization.³⁴

This study has implications for clinical quality monitoring and intervention planning among self-harming adolescents. High rates of ED and hospital utilization likely have a significant impact on self-harming adolescents' daily lives and future prospects. Time spent in the ED or hospital may disrupt schooling and employment trajectories, result in social isolation from family and peer networks,⁴⁸ and encourage overreliance on EDs for medical care.⁴⁹ Excess hospital-based service utilization may be an indicator of fragmented and irregular medical care.

However, higher rates of service utilization may also reflect *appropriate* use of emergency and inpatient care among seriously distressed adolescents, whose mental health needs may be too severe for management in outpatient settings. Families and providers caring for adolescents who deliberately self-harm must balance the youth's health needs with the possibility of social disruptions resulting from inpatient care. Future research should investigate whether self-harming adolescents' high rates of utilization stem from true medical need, barriers to receiving outpatient care, overall higher levels of engagement with the mental healthcare system, or other factors. From a clinical perspective, integrated care models that use mental health specialists to support primary care providers in delivering mental health care, disease management, and client education may be well-suited to addressing the broad health needs observed among adolescent deliberate self-harm patients.^{50,51} Universal suicide risk screening and mental health assessment in adolescent ED patients may also result in clinical benefit.^{52,53}

Limitations

This study had several limitations. The principal diagnostic position was used to categorize a visit's primary complaint as psychiatric vs. non-psychiatric. Medical coders do not always accurately record the patient's primary complaint, which may have resulted in misclassification of this variable. Visits occurring out-of-state were unobservable,³⁴ and information on many important aspects of adolescents' health and health care, including their outpatient visits, prescription medications, and untreated illness, was unavailable.⁹ The comparison groups comprised other ED patients; however, we think this likely biased the estimated associations towards the null since ED patients are less healthy than the general population.⁵⁴

Conclusions

Results from this study demonstrate that adolescent deliberate self-harm is associated with long-lasting and costly patterns of health service utilization, especially for psychiatric complaints. In light of increasing rates of adolescent self-harm, future research with this patient population should investigate the mechanisms underlying this pattern, identify any

factors that confer excess risk *among* self-harming youths,⁵⁵ and consider incorporating healthcare utilization as a key patient outcome.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Financial support This project was funded through National Institutes of Health grant R15 MH113108-01 to S.G.M., P.B., M.C., and D.W. The sponsor had no role in the study design; collection, analysis, or interpretation of data; writing of the report, or decision to submit the article for publication. No financial disclosures were reported by the authors of this paper.

References

- Centers for Disease Control and Prevention. Web-Based Injury Statistics Query and Reporting System (WISQARS): 10 Leading Causes of Nonfatal Violence-Related Injury. 2016 <https://webappa.cdc.gov/sasweb/ncipc/nfilead.html>
- Asarnow JR, Baraff LJ, Berk M, et al. An emergency department intervention for linking pediatric suicidal patients to follow-up mental health treatment. *Psychiatr Serv* 2011;62:1303–9. [PubMed: 22211209]
- Asarnow JR, Berk M, Hughes JL, Anderson NL. The SAFETY Program: A treatment-development trial of a cognitive-behavioral family treatment for adolescent suicide attempters. *J Clin Child Adolesc Psychol* 2015;44(1):194–203. [PubMed: 25255931]
- Mars B, Heron J, Crane C, et al. Clinical and social outcomes of adolescent self harm: population based birth cohort study. *BMJ* 2014;349:g5954. [PubMed: 25335825]
- Goldman-Mellor SJ, Caspi A, Harrington H, et al. Suicide attempt in young people: A signal for long-term health care and social needs. *JAMA Psychiatry* 2014;71(2):119–27. [PubMed: 24306041]
- Herbert A, Gilbert R, Gonzalez-Izquierdo A, Pitman A, Li L. 10-Y risks of death and emergency re-admission in adolescents hospitalised with violent, drug- or alcohol-related, or self-inflicted injury: A population-based cohort study. *PLoS Med* 2015;12(12):e1001931–e1001931. [PubMed: 26714280]
- Ballard ED, Cwik M, Storr CL, Goldstein M, Eaton WW, Wilcox HC. Recent medical service utilization and health conditions associated with a history of suicide attempts. *Gen Hosp Psychiatry* 2014;36(4):437–41. [PubMed: 24713329]
- Shanahan L, Schorpp KM, Volpe VV, Linthicum K, Freeman JA. Developmental timing of suicide attempts and cardiovascular risk during young adulthood. *Heal Psychol* 2016;35(10):1135–43.
- Thacker SB, Stroup DF, Carande-Kulis V, Marks JS, Rov K, Gerberding JL. Measuring the public's health. *Public Health Rep* 2006;121:14–22. [PubMed: 16416694]
- Birnbaum HG, Kessler RC, Kelley D, Ben-Hamadi R, Joish VN, Greenberg PE. Employer burden of mild, moderate, and severe major depressive disorder: mental health services utilization and costs, and work performance. *Depress Anxiety* 2010;27(1):78–89. [PubMed: 19569060]
- Birnbaum HG, Berger WE, Greenberg PE, et al. Direct and indirect costs of asthma to an employer. *J Allergy Clin Immunol* 2002;109(2):264–70. [PubMed: 11842295]
- Marcuzzi D, Carr B, Liferidge A, Baehr N, Browne B. Trends in the contribution of emergency departments to the provision of health care in the USA. *Int J Heal Serv* 2017;0(0):1–22.
- Case A, Paxson C. Children's health and social mobility. *Futur Child* 2014;16(2):151–73.
- Doshi JA, Hodgkins P, Kahle J, et al. Economic impact of childhood and adult attention-deficit/hyperactivity disorder in the United States. *J Am Acad Child Adolesc Psychiatry* 2012;51(10):990–1002. [PubMed: 23021476]
- Fletcher JM, Richards MR. Diabetes's "health shock" to schooling and earnings: Increased dropout rates and lower wages and employment in young adults. *Health Aff* 2012;31(1):27–34.

16. Park MJ, Adams SH, Irwin CE. Health care services and the transition to young adulthood: Challenges and opportunities. *Acad Pediatr* 2011;11(2):115–22. [PubMed: 21296043]
17. Dowling C, Rechis R, Nutt S, et al. Estimating the health and economic burden of cancer among those diagnosed as adolescents and young adults. *Health Aff* 2014;33(6):1024–31.
18. Franklin JC, Ribeiro JD, Fox KR, et al. Risk factors for suicidal thoughts and behaviors: A meta-analysis of 50 years of research. *Psychol Bull* 2017;143(2):187–232. [PubMed: 27841450]
19. Orri M, Galera C, Turecki G, et al. Association of childhood irritability and depressive/anxious mood profiles with adolescent suicidal ideation and attempts. *JAMA Psychiatry* 2018;75(7):465–73. [PubMed: 29590281]
20. Marzuk PM, Hartwell N, Leon AC, Portera L. Executive functioning in depressed patients with suicidal ideation. *Acta Psychiatr Scand* 2005;112(4):294–301. [PubMed: 16156837]
21. Keilp JG, Gorlyn M, Russell M, et al. Neuropsychological function and suicidal behavior: Attention control, memory and executive dysfunction in suicide attempt. *Psychol Med* 2013;43(3):539–51. [PubMed: 22781400]
22. Bridge JA, Goldstein TR, Brent DA. Adolescent suicide and suicidal behavior. *J Child Psychol Psychiatry* 2006;47(3–4):372–94. [PubMed: 16492264]
23. Vingilis E, Wade T, Seeley J. Predictors of adolescent health care utilization. *J Adolesc* 2007;30(5):773–800. [PubMed: 17141307]
24. Viner RM, Ozer EM, Denny S, et al. Adolescence and the social determinants of health. *Lancet* 2012;379:1641–52. [PubMed: 22538179]
25. Clarke DE, Goodwin RD, Messias ELM, Eaton WW. Asthma and suicidal ideation with and without suicide attempts among adults in the United States: What is the role of cigarette smoking and mental disorders? *Ann Allergy, Asthma Immunol* 2008;100(5):439–46. [PubMed: 18517075]
26. Goldston DB, Kelley AE, Reboussin DM, et al. Suicidal ideation and behavior and noncompliance with the medical regimen among diabetic adolescents. *J Am Acad Child Adolesc Psychiatry* 1997;36(11):1528–36. [PubMed: 9394937]
27. Burns CD, Cortell R, Wagner BM. Treatment compliance in adolescents after attempted suicide: A two-year follow-up study. *J Am Acad Child Adolesc Psychiatry* 2009;47(8):948–57.
28. Spirito A, Boergers J, Donaldson D, Bishop D, Lewander W. An intervention trial to improve adherence to community treatment by adolescents after a suicide attempt. *J Am Acad Child Adolesc Psychiatry* 2002;41(4):435–42. [PubMed: 11931600]
29. Sobolewski B, Richey L, Kowatch RA, Grupp-Phelan J. Mental health follow-up among adolescents with suicidal behaviors after emergency department discharge. *Arch Suicide Res* 2013;17(4):323–34. [PubMed: 24224667]
30. Trautman PD, Stewart N, Morishima A. Are adolescent suicide attempters noncompliant with outpatient care? *J Am Acad Child Adolesc Psychiatry* 1993;32(1):89–94. [PubMed: 8428890]
31. Kennedy SP, Baraff LJ, Suddath RL, Asarnow JR. Emergency department management of suicidal adolescents. *Ann Emerg Med* 2004;43(4):452–60. [PubMed: 15039687]
32. Kashiwara D, Carper K. National health care expenses in the U.S. civilian noninstitutionalized population, 2009 (Statistical Brief #355). Rockville, MD: 2012.
33. Public Policy Institute of California. Just the Facts: California's Population. 2017 <https://www.ppic.org/publication/californias-population/>
34. Goldman-Mellor S, Kwan K, Boyajian J, et al. Predictors of self-harm emergency department visits in adolescents: A statewide longitudinal study. *Gen Hosp Psychiatry* 2019;56:28–35. [PubMed: 30553125]
35. Elixhauser A, Steiner C, Palmer L. Clinical classifications software (CCS) Rockville, MD: 2014 <http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp>
36. Centers for Medicare and Medicaid Services. Acute inpatient prospective payment system. 2017 <https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/Acute-Inpatient-Files-for-Download.html>
37. Specification Mullahy J. and testing of some modified count data models. *J Econom* 1986;33(3):341–65.

38. Tsiachristas A, McDaid D, Casey D, et al. General hospital costs in England of medical and psychiatric care for patients who self-harm: A retrospective analysis. *The Lancet Psychiatry* 2017;4(10):759–67. [PubMed: 28890321]
39. Basu A, Manning WG, Mullahy J. Comparing alternative models: Log vs Cox proportional hazard? *Health Econ* 2004;13(8):749–65. [PubMed: 15322988]
40. Liang K-Y, Zeger SL. Longitudinal data analysis using generalized linear models. *Biometrika* 1986;73(1):13–22.
41. Rogers W Regression standard errors in clustered samples. *Stata Tech Bull* 1994;3(13):19–23.
42. Mars B, Heron J, Crane C, et al. Clinical and social outcomes of adolescent self harm: population based birth cohort study. *BMJ* 2014;349(oct20 5):g5954–g5954. [PubMed: 25335825]
43. Finkelstein Y, Macdonald EM, Hollands S, et al. Long-term outcomes following self-poisoning in adolescents: A population-based cohort study. *The Lancet Psychiatry* 2015;2(6):532–9. [PubMed: 26360449]
44. Niederkrotenthaler T, Tinghög P, Alexanderson K, et al. Future risk of labour market marginalization in young suicide attempters: A population-based prospective cohort study. *Int J Epidemiol* 2014;43(5):1520–30. [PubMed: 25102855]
45. Shah AJ, Veledar E, Hong Y, Bremner JD, Vaccarino V. Depression and history of attempted suicide as risk factors for heart disease mortality in young individuals. *Arch Gen Psychiatry* 2011;68(11):1135–42. [PubMed: 22065529]
46. Herbert A, Gilbert R, Cottrell D, Li L. Causes of death up to 10 years after admissions to hospitals for self-inflicted, drug-related or alcohol-related, or violent injury during adolescence: A retrospective, nationwide, cohort study. *Lancet* 2017;390(10094):577–87. [PubMed: 28552365]
47. Ostamo A, Lonnqvist J. Excess mortality of suicide attempters. *Soc Psychiatry Psychiatr Epidemiol* 2001;36:29–35. [PubMed: 11320805]
48. Taylor RM, Gibson F, Franck LS. The experience of living with a chronic illness during adolescence: A critical review of the literature. *J Clin Nurs* 2008;17(23):3083–91. [PubMed: 19012778]
49. Fosarelli PD, DeAngelis C, Mellits ED. Health services use by children enrolled in a hospital-based primary care clinic: A longitudinal perspective. *Pediatrics* 1987;79(2):196–202. [PubMed: 3808792]
50. Grimes KE, Creedon TB, Webster CR, Coffey SM, Hagan GN, Chow CM. Enhanced child psychiatry access and engagement via integrated care: A collaborative practice model with pediatrics. *Psychiatr Serv* 2018;69(9):986–92. [PubMed: 30041586]
51. Sunderji N, Ion A, Ghavam-Rassoul A, Abate A. Evaluating the implementation of integrated mental health care: A systematic review to guide the development of quality measures. *Psychiatr Serv* 2017;68(9):891–8. [PubMed: 28502244]
52. Boudreaux ED, Camargo CA, Arias SA, et al. Improving suicide risk screening and detection in the emergency department. *Am J Prev Med* 2016;50(4):445–53. [PubMed: 26654691]
53. Ballard ED, Cwik M, Van Eck K, et al. Identification of at-risk youth by suicide screening in a pediatric emergency department. *Prev Sci* 2017;18(2):174–82. [PubMed: 27678381]
54. Weber EJ, Showstack JA, Hunt KA, Colby DC, Callahan ML. Does lack of a usual source of care or health insurance increase the likelihood of an emergency department visit? Results of a national population-based study. *Ann Emerg Med* 2005;45(1):4–12. [PubMed: 15635299]
55. Rice SM, Purcell R, McGorry PD. Adolescent and young adult male mental health: Transforming system failures into proactive models of engagement. *J Adolesc Heal* 2018;62(3):S9–17.

Highlights

- Adolescent deliberate self-harm patients had significantly greater emergency department utilization, inpatient admissions, and inpatient costs over 5 years of follow-up when compared to other adolescent patients, including those seen for mental health problems.
- This excess service utilization involved both non-psychiatric and psychiatric complaints, underscoring the broad spectrum of self-harming youths' health-related needs.

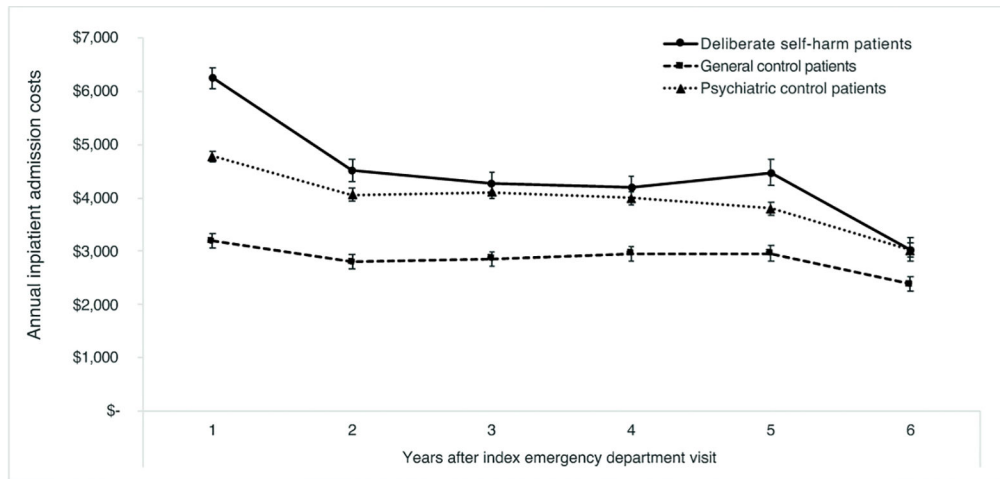


Figure 1. Average inpatient admission costs, per year of follow-up, among deliberate self-harm patients, patients in the psychiatric control group, and patients in the general control group.

Table 1.

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

	Self-harm patients (N=5,396)		Matched control patients (N=14,924)		Matched psychiatric control patients (N=15,835)	
	n	%	n	%	n	%
<i>Characteristic at index visit</i>						
Patient age in years, mean ± SD	16.6 ± 2.0		16.6 ± 2.0		16.4 ± 2.3	
Patient sex						
Male	1,949	36.1%	5,396	36.2%	5,976	37.7%
Female	3,447	63.9%	9,525	63.8%	9,859	62.3%
Patient race/ethnicity						
White	2,316	42.9%	5,588	37.5%	6,034	38.1%
Black	602	11.2%	1,791	12.0%	1,985	12.5%
Hispanic	1,874	34.7%	5,845	39.2%	6,122	38.7%
Asian/Pacific Islander	196	3.6%	580	3.9%	571	3.6%
Other	408	7.6%	1,117	7.5%	1,123	7.1%
Patient insurance type						
Private	2,283	42.3%	6,383	42.8%	6,758	42.7%
Medicaid	2,346	43.5%	5,924	39.7%	6,569	41.5%
Self-pay	575	10.7%	2,113	14.2%	2,025	12.8%
Other	192	3.6%	500	3.4%	482	3.0%
Patient disposition						
Discharged home	2,419	44.8%	13,766	92.3%	11,266	71.2%
Admitted as inpatient	2,794	51.8%	867	5.8%	4,216	26.6%
Other	183	3.4%	288	1.9%	353	2.2%
<i>Patient ED utilization, 2006–09</i>						
Total visits, mean ± SD	2.10 ± 3.5		1.45 ± 2.4		1.90 ± 3.2	
Any mental health visit	1,174	21.8%	1,047	7.0%	3,165	20.0%
Any substance use visit	427	7.9%	364	2.4%	813	5.1%

Subsequent emergency department utilization, inpatient admissions, and inpatient costs among adolescent self-harm and matched general control patients, with follow-up through Sept. 30, 2015.

Table 2.

	Emergency department utilization					
	Total emergency department visits		Emergency department visits for psychiatric complaints		Emergency department visits for non-psychiatric complaints	
	Mean ± SD	IRR ^a (95% CI)	Mean ± SD	IRR ^a (95% CI)	Mean ± SD	IRR ^a (95% CI)
General control patients	4.3 ± 7.0	1.00	0.2 ± 1.0	1.00	4.10 ± 6.7	1.00
Self-harm patients	7.2 ± 12.1	1.39 (1.32, 1.46)	1.2 ± 3.8	3.62 (3.14, 4.16)	6.0 ± 10.0	1.27 (1.20, 1.33)
	Inpatient admissions					
	Total inpatient admissions		Inpatient admissions for psychiatric complaints		Inpatient admissions for non-psychiatric complaints	
	Mean ± SD	IRR ^a (95% CI)	Mean ± SD	IRR ^a (95% CI)	Mean ± SD	IRR ^a (95% CI)
General control patients	0.6 ± 1.8	1.00	0.1 ± 0.8	1.00	0.5 ± 1.6	1.00
Self-harm patients	1.7 ± 3.9	1.81 (1.65, 1.99)	1.1 ± 3.2	5.55 (4.64, 6.63)	0.7 ± 1.6	1.04 (0.93, 1.16)
	Inpatient costs					
	Total inpatient costs		Inpatient costs for psychiatric complaints		Inpatient costs for non-psychiatric complaints	
	Mean ± SD	Exp(b) ^b (95% CI)	Mean ± SD	Exp(b) ^b (95% CI)	Mean ± SD	Exp(b) ^b (95% CI)
General control patients	\$9,976 ± 20,031	1.00	\$1,527 ± 7,357	1.00	\$8,449 ± 18,865	1.00
Self-harm patients	\$16,571 ± 25,238	1.21 (1.10, 1.34)	\$9,934 ± 20,803	3.98 (3.30, 4.79)	\$6,637 ± 12,764	0.70 (0.62, 0.79)

Full model results, including covariates and dispersion parameters for the negative binomial models estimating incidence rate ratios, are available in Online Supplement.

^aIncidence rate ratio (IRR) models control for patient age, race/ethnicity, payer, and disposition at index visit, as well as patient history of total ED visits, any mental health visit, and any substance use visit during 2006–2009.

^bExp(b) is interpreted as the multiplicative effect on mean costs associated with being in the self-harm patient group vs. the control patient group. All models controlled for patient age, race/ethnicity, payer, and disposition at index visit, as well as patient history of total ED visits, any mental health visit, and any substance use visit during 2006–2009.

Table 3.

Subsequent emergency department utilization, inpatient admissions, and inpatient costs among adolescent deliberate self-harm and matched psychiatric control patients, with follow-up through Sept. 30, 2015.

	Emergency department utilization						
	Total emergency department visits		Emergency department visits for psychiatric complaints		Emergency department visits for non-psychiatric complaints		
	Mean ± SD	IRR ^a (95% CI)	Mean ± SD	IRR ^a (95% CI)	Mean ± SD	IRR ^a (95% CI)	
Psychiatric control patients	6.6 ± 10.8	1.00	1.1 ± 3.2	1.00	5.5 ± 9.4	1.00	
Self-harm patients	7.2 ± 12.1	1.03 (0.99, 1.08)	1.2 ± 3.7	0.88 (0.80, 0.97)	6.0 ± 10.1	1.08 (1.03, 1.14)	
			Inpatient admissions				
	Total inpatient admissions		Inpatient admissions for psychiatric complaints		Inpatient admissions for non-psychiatric complaints		
	Mean ± SD	IRR ^a (95% CI)	Mean ± SD	IRR ^a (95% CI)	Mean ± SD	IRR ^a (95% CI)	
Psychiatric control patients	1.3 ± 3.1	1.00	0.7 ± 2.4	1.00	0.6 ± 1.7	1.00	
Self-harm patients	1.7 ± 3.9	1.12 (1.04, 1.20)	1.0 ± 3.2	1.14 (1.03, 1.27)	0.7 ± 1.6	1.17 (1.07, 1.27)	
			Inpatient costs				
	Total inpatient costs		Inpatient costs for psychiatric complaints		Inpatient costs for non-psychiatric complaints		
	Mean ± SD	Exp(b) ^b (95% CI)	Mean ± SD	Exp(b) ^b (95% CI)	Mean ± SD	Exp(b) ^b (95% CI)	
Psychiatric control patients	\$14,583 ± 23,494	1.00	\$8,328 ± 16,993	1.00	\$6,255 ± 17,013	1.00	
Self-harm patients	\$16,631 ± 25,376	1.05 (0.99, 1.13)	\$9,964 ± 20,736	1.09 (0.99, 1.21)	\$6,668 ± 13,152	1.11 (1.01, 1.23)	

Full model results, including covariates and dispersion parameters for the negative binomial models estimating incidence rate ratios, are available in Online Supplement.

^aIncidence rate ratio (IRR) models control for patient age, race/ethnicity, payer, disposition, and zipcode-level median income at index visit, as well as patient history of total ED visits, any mental health visit, and any substance use visit during 2006–2009.

^bExp(b) is interpreted as the multiplicative effect on mean costs associated with being in the self-harm patient group vs. the control patient group. All models controlled for patient age, race/ethnicity, payer, disposition, and zipcode-level median income at index visit, as well as patient history of total ED visits, any mental health visit, and any substance use visit during 2006–2009.