RESEARCH ARTICLE

Repeat Self-Inflicted Injury Among U.S. Youth in a Large Medical Claims Database

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Introduction: This study describes characteristics of nonfatal self-inflicted injuries and incidence of repeat self-inflicted injuries among a large convenience sample of youth (aged 10−24 years) with Medicaid or commercial insurance.

Methods: In 2018, Truven Health MarketScan medical claims data were used to identify youth with a self-inflicted injury in 2013 (or index self-inflicted injury) diagnosed in any inpatient or outpatient setting. Patients with 2 years of healthcare claims data (1 year before/after index self-inflicted injury) were assessed. Patient and injury characteristics, repeat self-inflicted injuries ≤1 year, time to repeat self-inflicted injury, and number of emergency department and urgent care facility visits per patient are reported. A regression model assessed factors associated with repeat self-inflicted injuries.

Results: Among 4,681 self-inflicted injury patients, 70% were female. More than 71% of patients were treated for comorbidities (50% for depression) ≤1 year preceding the index self-inflicted injury. Poisoning was the most common index self-inflicted injury mechanism (60% of patients). Approximately 52% of patients had one or more emergency department visit and 1% had one or more urgent care facility visit, respectively, during the 2-year observation period. More than 11% of patients repeated self-inflicted injury ≤1 year (and 3% ≤7 days). Repeat self-inflicted injury was associated with younger patient age, being female, a self-inflicted injury event preceding the index self-inflicted injury, index self-inflicted injury treatment setting, and patient comorbidities.

Conclusions: Approximately one in ten youth repeated self-inflicted injury within 1 year and nearly half of youth with clinically treated self-inflicted injuries never received care in hospitals or emergency departments. Physicians and families should be aware of risk factors for repeat self-inflicted injury, including mental health comorbidities. Multilevel strategies are needed to prevent youth self-inflicted injuries.
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INTRODUCTION

The U.S. rate of hospital emergency department (ED) visits for nonfatal self-inflicted injuries (SII; inclusive of suicidal and nonsuicidal intent) among youth aged 10−24 years increased substantially during 2009−2015.[1] Among females aged 10−14 years, ED visits nearly tripled (from 109.8 to 317.7 per 100,000 people).[1] Data from the United Kingdom and Canada also indicate substantial increases in hospital-based (ED or inpatient) SII treatment among females aged less than 18 years over the same period.[2,3] Only one in ten youth with SII receive hospital-based treatment, suggesting just

a small portion of affected youth are identified in the hospital data used to document these recent increases.[4,5] Large U.S. school-based convenience sample surveys have estimated the lifetime prevalence of youth nonfatal self-injurious behavior is 8% of third graders,[6] 4%[6] to 8% (past-year prevalence)[7] of sixth to eighth graders,

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13%[6] to 16%[8] of ninth to twelfth graders, and 15%[9] to 17%[10] of college students.

A majority of youth who self-injure do so multiple times,[10—13] and people who self-injure are at substantially greater risk of suicide.[9,14—17] Most longitudinal research on healthcare contacts—including repeat injury—among youth with SII comes from non−U.S. ED registries. A recent systematic review of studies worldwide over the preceding 30 years reported the average 1-year incidence of repeat SII was 16% (*n*=78 studies) and fatal self-harm was 2% (*n*=40 studies) among patients of all ages initially treated for SII in hospital settings.[18] There were just three U.S. studies in that systematic review; the most recent used data from 1980, and none focused on youth.[19—21]

Large U.S. medical claims databases offer an opportunity to investigate healthcare contacts over time among youth with SII in all clinical settings (i.e., not limited to hospitals). The aim of this study is to describe characteristics of SII and repeat SII incidence within 1 year among a large nationwide convenience sample of U.S. youth with Medicaid or commercial insurance.

METHODS

Study Sample

This study used publicly available data and no human subjects. In 2018, authors used Truven Health MarketScan data for patients aged 10−24 years with commercial or Medicaid insurance and identified the first date of an inpatient or outpatient medical claim with an SII diagnosis in 2013 (or index SII) for this analysis. MarketScan includes paid insurance claims and encounters from participating large employers, MCOs, hospitals, electronic medical record providers, and some Medicare and Medicaid contributors.[22] MarketScan is not representative of the U.S. population. In 2013, 62% of the U.S. population had private health insurance (e.g., employer), 18% had Medicaid, and 17% were uninsured.[23] MarketScan does not report mortality; therefore, it was not possible to assess fatal self-harm.

Measures

SII was defined by ICD-9-CM external cause codes (E-codes) E950-9 (i.e., suicide and SII; or SII diagnosis). Transition to ICD-10-CM diagnosis coding took place in October 2015, or the end of the period (2009−2015) during which a substantial increase in ED visits for youth SII has been documented.[1] Coding consistency for this study's full observation period guided authors' decision to use year 2013 index injury data and 2014 as a follow-up period. E-codes are not explicitly used for payment, and not all injury medical claims include E-codes; however, E-codes are the only way to identify injury intent (i.e., self-harm) using ICD-9-CM diagnoses.

Investigation of subsequent SII required that authors designate an index event to begin observation. Given the nature of administrative medical data, it was not possible to ensure that this was patients' first-ever SII event. To ensure that each patient's first

2013 SII record (i.e., index SII) was a new event (and not continued treatment from a previous SII event), authors excluded patients who were existing inpatients on January 1, 2013, and patients with an index SII date before January 30, 2013, who were treated for the same injury mechanism (e.g., self-inflicted poisoning) in a non-ED or urgent care facility (UCF) setting within the previous 30 days. Patients with 12 months of continuous insurance enrollment before and after the index SII date (i.e., spanning different parts of 2012−2014 per patient, depending on the 2013 index SII date) comprised the analysis sample (Figure 1).

Patient sex, age at index SII, comorbidities (e.g., depression), insurance payer type (Medicaid or commercial), all clinical settings (i.e., clinician office, ambulance, UCF, ED, inpatient) where the patient was treated on the day the index SII was diagnosed (or initial treatment), index SII mechanism, preceding SII within 1 year before the index SII, and repeat SII within 1 year after index SII were assessed using source data. Comorbidities were identified by ICD-9-CM diagnosis codes (as defined in the Agency for Healthcare Research and Quality's Elixhauser Comorbidity Index, Version 3.7) in each patient's inpatient and outpatient medical claims within 1 year preceding and including the patient's index SII date. Clinical treatment settings were identified by service place (e.g., UCF) and service category (e.g., ED-related) information reported in the data source. Some patients were treated in multiple clinical settings on the index SII date (e.g., ambulance and ED). Inpatient treatment on the day following the index SII diagnosis date was assessed as initial index SII treatment. Injury mechanism was defined by standard E-code classifications.[24] E-codes with specified mechanism (e.g., E955.0 "Suicide and self-inflicted injury by handgun") were prioritized over unspecified mechanism (e.g., E958.9, "Suicide and self-inflicted injury by unspecified means") if a patient had multiple different SII diagnosis codes on the index SII date.

Medical claims do not typically include explicit distinction between initial events and follow-up care. This study's analysis of index and subsequent SII therefore required definitions using administrative codes (e.g., diagnosis) to identify repeat SII (i.e., a new SII event). Repeat SII within 1 year of the index SII was defined as a medical claim for:

1. UCF or ED services with any SII diagnosis on any date after the index SII date; or
2. treatment in any other clinical setting (i.e., neither an ED nor UCF) for the same SII mechanism as the index SII (i.e., a claim including any of the same E950-9 codes) occurring ≥30 days after the index SII; or
3. treatment in any clinical setting on any date after the index SII date for a different SII mechanism than the index SII (i.e., a claim with none of the same E950-9 codes).

Authors used the same method in reverse to identify patients with an SII within 1 year preceding the index SII.

Statistical Analysis

Authors used SAS, version 9.4 for analysis. Descriptive data are presented on patient and injury characteristics by age group (10−14 years, 15−19 years, 20−24 years), including number and proportion of patients by sex, type of comorbidities (those affecting >5% of total patients are reported individually), insurance payer type, index SII initial clinical treatment setting, index SII

mechanism, and preceding SII and repeat SII (i.e., relative to the index SII). Chi-square tests compared the proportion of patients in each of the two older age groups to the youngest age group for each of these factors. A logistic regression model assessed whether these factors were associated with repeat SII within 1 year. Authors separately report the number and proportion of patients with first repeat SII by index SII mechanism. For statistical reliability, SII mechanism sample sizes of <21 patients were not assessed for repeat SII incidence. A Kaplan−Meier plot demonstrates time from index SII date to first repeat SII. Authors also report the number of SII ED and UCF visits (defined by a medical claim for any SII diagnosis in an ED or UCF) during the entire observation period per patient (or 2 years; within 1 year before/after the index SII). The ED/UCF analysis aimed to provide insight into the proportion of youth SII patients in this sample that had clinical treatment entirely outside of ED/UCF settings; this information can contextualize data on the prevalence of U.S. youth SII ED visits.[1]

RESULTS

Among 4,681 youth SII patients (2,818 with commercial insurance and 1,863 with Medicaid; Figure 1), 70% were female (Table 1). More than 71% of patients were diagnosed with comorbidities within 1 year preceding the index SII date (Table 1). The most prevalent diagnosed comorbidities among all patients were depression (49% of patients), psychosis (24%), drug abuse (19%), chronic pulmonary disease (16%; the Elixhauser comorbidity classification includes asthma in this category), neurologic disorders (12%), and

alcohol abuse (9%; Table 1). Patients aged 20−24 years had the highest prevalence of any comorbidity (79%; Table 1). That higher prevalence was due to all aforementioned comorbidity types except chronic pulmonary disease (similar prevalence among all age groups; Table 1).

Nearly 10% of patients were treated in a clinician office, 16% in an ambulance, 1% in a UCF, 50% in an ED, and 48% as inpatients on the day that their index SII was diagnosed (Table 1). Poisoning was the most prevalent single index SII mechanism among all age groups (60% of patients), followed by cut/pierce injuries (24%; Table 1). Three percent of total patients had a preceding SII within 1 year before the index SII (Table 1). More than 60% of patients had commercial insurance, reflecting the higher prevalence of commercial insurance patients in the data source (Table 1).

Compared with the older two age groups, a significantly lower proportion of patients in the group aged 10−14 years had commercial insurance (53%), diagnosed comorbidities (61%), initial index SII treatment in an ambulance (13%) or as inpatients (45%; significantly different from age 20−24 years patients), and poisoning index SII mechanism (50%; Table 1). A significantly higher proportion of patients aged 10−14 years had index SII initial clinical treatment in clinician offices (14%), and cut/pierce (29%), suffocation (3%), or unspecified (8%; significantly different from age 15−19 years) index SII mechanism (Table 1).
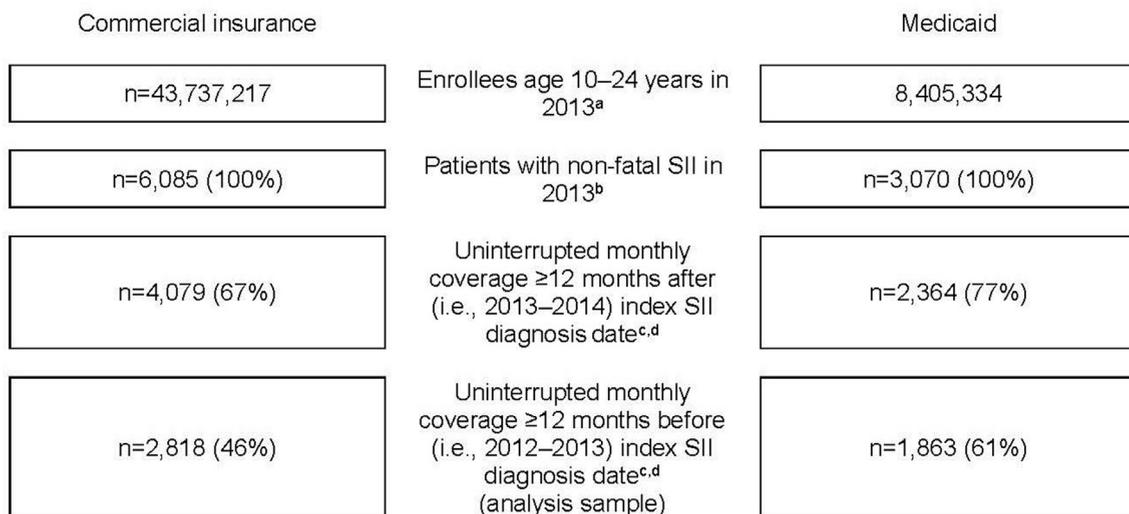

Figure 1. Sample selection.
[a]Ages 10−24 years in 2013 determined by year of birth 1989−2004 for Medicaid enrollees.
[b]Non-fatal self-inflicted injury (SII) defined by ICD-9-CM codes E950−959 (suicide and self-inflicted injury). Patient age defined by date of service.
[c]Index SII diagnosis date (date, month, year) defined as the first inpatient or outpatient diagnosis of non-fatal self-inflicted injury in calendar year 2013.
[d]Enrollment identified in months in the source dataset (e.g., a patient with an index SII diagnosis on any date in September 2013 [i.e., calendar month 9] was included in the analysis sample if the patient was enrolled continuously through 2014 month 9 and including 2012 month 9).

Table 1. Patient and Injury Characteristics

Measure	Summary statistics				Regression model, repeat injury ≤1 year of index SII, AOR (95% CI) (N=4,681)
	Age 10−14 years (*n*=1,006)	Age 15−19 years (*n*=2,629)	Age 20−24 years (*n*=1,046)	All (N=4,681)	
Patient					
Age at index SII diagnosis (2013), years, mean (SE)	13.2 (0.03)	16.6 (0.03)	21.7 (0.04)	17.0 (0.05)	**0.96 (0.93, 0.99)[a]**
Sex, female, *n* (%) patients	788 (78.3)	**1,859 (70.7)**	**642 (61.4)**	3,289 (70.3)	**1.61 (1.28, 2.03)**
Comorbidities[b] (2012 − 2013), *n* (%) patients					
Any comorbidity	613 (60.9)	**1,886 (71.7)**	**828 (79.2)**	3,327 (71.1)	NA
Depression	439 (43.6)	**1,321 (50.2)**	**553 (52.9)**	2,313 (49.4)	**1.58 (1.29, 1.92)**
Psychoses	159 (15.8)	**583 (22.2)**	**366 (35.0)**	1,108 (23.7)	**1.33 (1.06, 1.65)**
Drug abuse	67 (6.7)	**506 (19.2)**	**334 (31.9)**	907 (19.4)	1.20 (0.93, 1.54)
Chronic pulmonary disease	152 (15.1)	416 (15.8)	163 (15.6)	731 (15.6)	**1.37 (1.08, 1.73)**
Other neurological disorders	94 (9.3)	287 (10.9)	**185 (17.7)**	566 (12.1)	1.28 (0.98, 1.68)
Alcohol abuse	16 (1.6)	**196 (7.5)**	**220 (21.0)**	432 (9.2)	1.00 (0.71, 1.40)
Other	114 (11.3)	**419 (15.9)**	**360 (34.4)**	893 (19.1)	1.03 (0.79, 1.34)
Insurance payer type, *n* (%) patients					
Commercial	534 (53.1)	1,527 (58.1)	757 (72.4)	2,818 (60.2)	ref
Medicaid	472 (46.9)	**1,102 (41.9)**	**289 (27.6)**	1,863 (39.8)	1.10 (0.91, 1.33)
Index SII (2013), *n* (%) patients					
Initial clinical treatment setting					
Emergency department	484 (48.1)	1,347 (51.2)	497 (47.5)	2,328 (49.7)	0.93 (0.71, 1.22)
Inpatient	451 (44.8)	1,255 (47.7)	**556 (53.2)**	2,262 (48.3)	**0.71 (0.54, 0.95)**
Ambulance	132 (13.1)	**421 (16.0)**	190 (18.2)	743 (15.9)	1.26 (0.98, 1.61)
Clinician office	145 (14.4)	**233 (8.9)**	**83 (7.9)**	461 (9.8)	1.10 (0.78, 1.54)
Urgent care facility	7 (0.7)	16 (0.6)	6 (0.6)	29 (0.6)	0.66 (0.15, 2.86)
Other[c]	232 (23.1)	666 (25.3)	264 (25.2)	1,162 (24.8)	NA
Injury mechanism[d]					
Poisoning	508 (50.5)	**1,639 (62.3)**	**651 (62.2)**	2,798 (59.8)	0.92 (0.61, 1.39)
Cut/pierce	292 (29.0)	**584 (22.2)**	**223 (21.3)**	1,099 (23.5)	1.04 (0.68, 1.60)
Suffocation	33 (3.3)	**49 (1.9)**	**16 (1.5)**	98 (2.1)	0.91 (0.42, 1.98)
Motor vehicle	7 (0.7)	11 (0.4)	6 (0.6)	24 (0.5)	1.01 (0.22, 4.55)
Falls	9 (0.9)	6 (0.2)	4 (0.4)	19 (0.4)	0.85 (0.18, 3.95)
Firearms	0 (0)	8 (0.3)	7 (0.7)	15 (0.3)	2.84 (0.60, 13.52)
Fire/flame	0 (0)	6 (0.2)	5 (0.5)	11 (0.2)	[e]
Drowning/submersion	1 (0.1)	0 (0)	3 (0.3)	4 (0.1)	[e]
Natural/environmental	3 (0.3)	0 (0.0)	1 (0.1)	4 (0.1)	[e]
Hot object/substance	1 (0.1)	2 (0.1)	0 (0)	3 (0.1)	[e]
Multiple mechanism	6 (0.6)	20 (0.8)	5 (0.5)	31 (0.7)	0.28 (0.04, 2.13)
Other specified, classifiable	4 (0.4)	11 (0.4)	1 (0.1)	16 (0.3)	0.76 (0.22, 2.68)
Other specified, not elsewhere classifiable	67 (6.7)	168 (6.4)	56 (5.4)	291 (6.2)	0.84 (0.48, 1.48)
Unspecified	75 (7.5)	**125 (4.8)**	68 (6.5)	268 (5.7)	ref

Table 1. Patient and Injury Characteristics (*continued*)

	Summary statistics				Regression model, repeat injury ≤1 year of index SII, AOR (95% CI) (N=4,681)
Measure	Age 10−14 years (*n*=1,006)	Age 15−19 years (*n*=2,629)	Age 20−24 years (*n*=1,046)	All (N=4,681)	
Multiple non-fatal self-inflicted injuries					
Preceding injury ≤1 year of index SII (2012−2013), *n* (%)	20 (2.0)	88 (3.3)	34 (3.3)	142 (3.0)	**1.65 (1.08, 2.53)**
Follow-up injury ≤1 year of index SII (2013−2014), *n* (%)	129 (12.8)	287 (10.9)	111 (10.6)	527 (11.3)	NA

Note: Boldface indicates statistical significance (*p*<0.05). Bold text in summary statistics columns refers to comparisons of Age 15−19 years group or Age 20−24 years group to Age 10−14 years group; χ^2 test conducted for rows with total sample size ≥21. Bold text in regression model column indicates variable was significantly associated with subsequent SII in the regression model.
[a]Age assessed as continuous variable.
[b]Patients could each have ≥1 comorbidities. Other includes comorbidities affecting <5% of patients: obesity, hypertension, fluid and electrolyte disorders, weight loss, deficiency anemias, diabetes, valvular disease, coagulopathy, rheumatoid arthritis, paralysis, congestive heart failure, liver disease, hypothyroidism, renal failure, chronic blood loss anemia, lymphoma, peripheral vascular disease, solid tumor without metastasis, pulmonary circulation disease, metastatic cancer, AIDS.
[c]Includes non-emergency department hospital outpatient, rural health clinic, federally qualified health center, school, patient home, and others.
[d]Injury mechanism definitions: all injury (E950−E959), cut/pierce (E956), drowning/submersion (E954), fall (E957), fire/burn (E958.1, E958.2, E958.7), fire/flame (E958.1), hot object/substance (E958.2, E948.7), firearm (E955.0−.4), motor vehicle traffic (E958.5), transport, other (E958.6), natural/environmental (E958.3), poisoning (E950−E952), suffocation (E953), other (other specified and classifiable (E955.5, E955.6, E955.7, E955.9, E955.0, E958.4)); other specified, not elsewhere classifiable (E958.8, E959), and unspecified (E958.9)). Reproduced from www. cdc.gov/injury/wisqars/ecode_matrix.html (Accessed February 17, 2017).
[e]Due to small sample sizes of patients with index SII mechanism drowning/submersion, fire/flame, hot object/substance, and natural/environmental, these patients were grouped with mechanism "other specified, classifiable" for the regression analysis.
NA, not assessed; SII, non-fatal self-inflicted injury.

More than 11% (*n*=527/4,681) of patients repeated SII within 1 year of the index SII (Table 1). Lower age (OR=0.96, 95% CI=0.93, 0.99), being female (OR=1.61, 95% CI=1.28, 2.03), prior diagnosis of depression (OR=1.58, 95% CI=1.29, 1.92), psychoses (OR=1.33, 95% CI=1.06, 1.65), chronic pulmonary disease (OR=1.37, 95% CI=1.08, 1.73), index SII inpatient initial treatment (OR=0.71, 95% CI=0.54, 0.95), and SII event in the year preceding the index SII (OR=1.65, 95% CI=1.08, 2.53) were associated with repeat SII within 1 year (Table 1).

Repeat SII rates ranged from 3% of patients with multiple index SII mechanisms to 13% of patients with cut/ pierce index SII mechanism (Table 2). Most sample sizes were too small to assess repeat SII by injury mechanism (i.e., same/different compared with index SII), although a far lower proportion of patients with index SII poisoning (30%, *n*=91/304) compared with cut/pierce (60%, *n*=87/145) used the same mechanism at the first repeat SII event (Table 2). First repeat SII occurred throughout the 1-year follow-up observation period for all age groups (Figure 2). At ≤7 days, 8−30 days, and 31−180 days since index SII, 3% (*n*=126/4,681), 1% (*n*=50/4,681), and 5% (*n*=216/4,681) of patients had medical treatment for a repeat SII event (Figure 2), respectively.

Just 52% of patients (*n*=2,443/4,681) with clinically treated SII had one or more SII ED visits during the total 2-year observation period per patient and 5% (*n*=239/ 4,681) of patients had two or more SII ED visits (Appendix Figure 1, available online). Less than 1% of patients (*n*=33/4,681) had one or more SII UCF visits (Appendix Figure 1, available online).

DISCUSSION

Retrospective analysis of U.S. medical claims data allowed this study to make three data contributions that may ultimately inform clinical and public health activities related to youth SII. First, this study appears to be the first large-sample assessment of repeat SII in the U.S. in decades, and the first to focus on youth SII.[15,18] This study reported the incidence of repeat SII within 1 year among youth with clinically diagnosed SII (11%) and reported that several observable factors in medical claims data (patient age, sex, comorbidities, preceding SII event, and index SII initial treatment setting) were associated with repeat SII.

Second, this study assessed the prevalence of clinically diagnosed comorbid conditions among youth SII patients, identifying that more than 70% of patients were diagnosed or treated for comorbidities within 1 year preceding the index SII. In other words, a majority of patients in this sample had underlying health conditions and contact with clinicians

Table 2. Number and Proportion of Patients With Repeat Injury Within 1 Year by Mechanism

Index SII mechanism[a]	Index SII, *n* patients (N=4,681)	Repeat SII, *n* (%)[b] (N=527)	Same mechanism as index, *n* (%)[c]	Different mechanism as index, *n* (%)[c]
Poisoning	2,798	304 (10.9)	91 (29.9)	213 (70.1)
Cut/pierce	1,099	145 (13.2)	87 (60.0)	58 (40.0)
Suffocation	98	10 (10.2)	NA	NA
Motor vehicles	24	2 (8.3)	NA	NA
Falls	19	NA	NA	NA
Firearms	15	NA	NA	NA
Fire/flame	11	NA	NA	NA
Drowning/submersion	4	NA	NA	NA
Natural/environmental	4	NA	NA	NA
Hot object/substance	3	NA	NA	NA
Multiple mechanism	31	1 (3.2)	NA	NA
Other specified, classifiable	16	NA	NA	NA
Other specified, not elsewhere classifiable	291	26 (8.9)	13 (50.0)	13 (50.0)
Unspecified	268	32 (11.9)	12 (37.5)	20 (62.5)

[a]Categories for index SII mechanism drowning/submersion, hot object/substance, and natural/environmental not included here due to small sample size.
[b]Percent of patients with index SII mechanism, or Column 2.
[c]Percent of patients with same/different repeat SII mechanism, or Column 3.
NA, not assessed (due to sample size <21); SII, non-fatal self-inflicted injury.

regarding those conditions shortly before SII. Third, this study's finding that only half of youth with clinically diagnosed SII were treated in an ED suggests a large proportion of youth with clinically diagnosed SII (i.e., only a subset of all youth with SII) are not identified in ED-based data.

This analysis estimated that among youth SII patients, younger age; being female; previous diagnosis of depression, psychosis, or chronic pulmonary disease (including asthma); and preceding SII event were associated with a higher likelihood of repeat SII within 1 year, and that inpatient treatment for index SII was associated with lower risk of repeat SII. The finding of increased risk for repeat SII among patients with mental health comorbidities is consistent with previous research reporting that long-standing psychosocial vulnerabilities are associated risk factors for repeat self-harm injury.[11] The finding of increased risk associated with a preceding SII event appears consistent with previous research indicating that some SII patients are chronically and severely affected.[12,25] The significant association between chronic pulmonary disease (including asthma) and repeat SII merits further investigation. The association of index SII inpatient treatment with reduced likelihood of repeat SII might indicate successful treatment following a severe self-harm event. This result merits further investigation.

This study's finding of 11% repeat SII within 1 year is slightly lower than the average 16% reported in a previous systematic review of (primarily non–U.S.) studies.[18] Unlike most studies in that review, which assessed only

hospital-treated index SII and repeat SII, this study assessed index SII and repeat SII diagnosed in any clinical setting.[8] One might assume that observing all clinical settings for repeat SII could incline the present study toward a higher repeat SII rate than the 16% observed in hospital-only studies (i.e., by capturing patients' non-hospital clinical care). On the other hand, by observing all clinical settings for an index SII diagnosis, the present study might have included patients with less severe index SII than hospital-based studies (and perhaps less likely to repeat), resulting in a lower overall rate of repeat SII compared with hospital-based studies. Another difference is that the present study assessed only insured patients. Previous research using ED visit data likely captured non-insured patients who potentially have additional risk factors for repeat SII.[1]

A logical next research goal would be to use U.S. medical claims or similar data to assess how many youth SII patients received appropriate treatment. However, evidence to guide clinical management of self-harm is sparse, rendering it difficult to define "appropriate treatment" for such a future study.[26,27] A recent systematic review and meta-analysis of SII interventions among children and youth concluded that the evidence base is extremely limited, although therapeutic assessment, mentalization therapy, and dialectical behavior therapy merit further evaluation.[27]

Because there is no one single biological or psychosocial determinant of self-harm, comprehensive prevention strategies that address a range of factors, in a range of
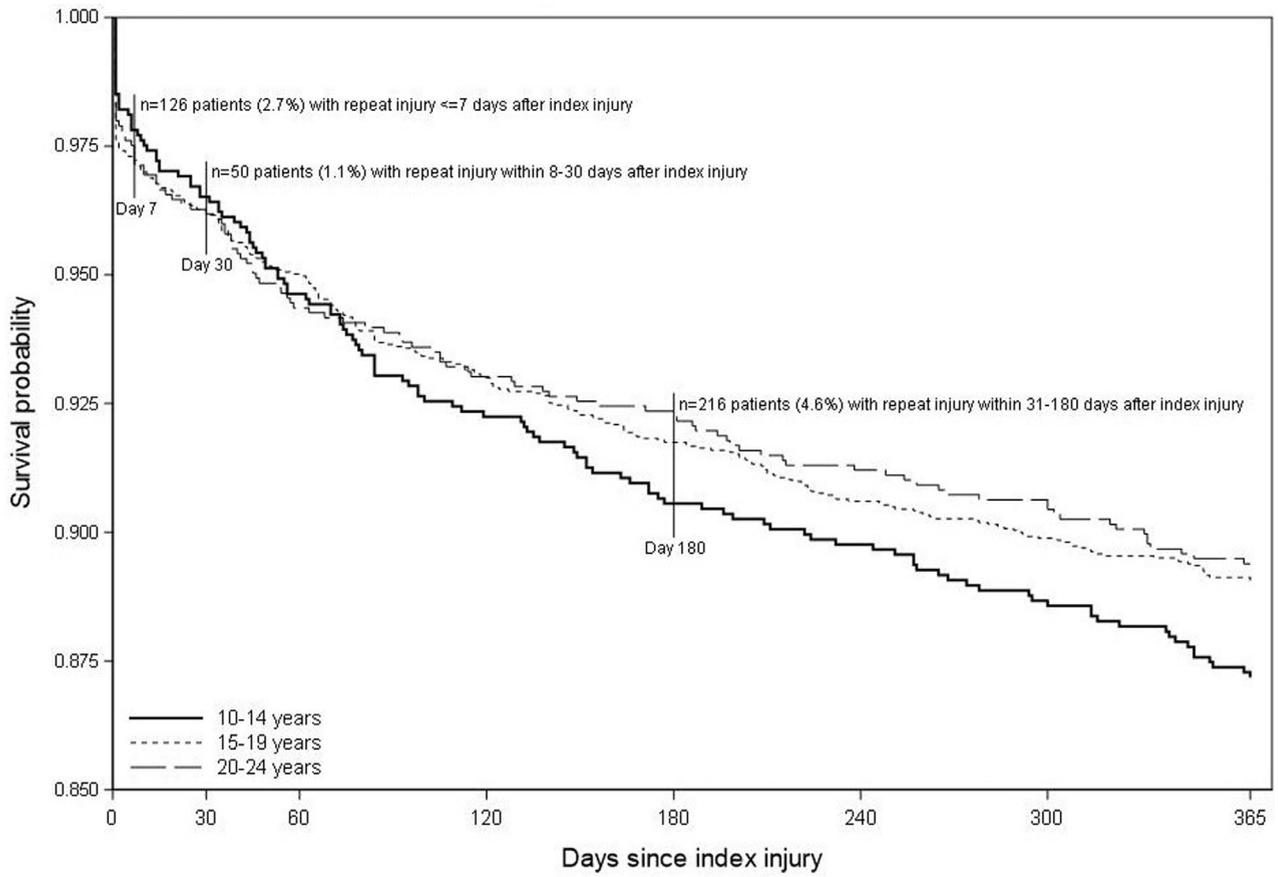
Figure 2. Time to repeat injury within 1 year after index injury (*n*=527/4,681 patients with repeat injury).

settings (e.g., school, community, healthcare) are needed. The Centers for Disease Control and Prevention's technical package to prevent suicide helps states and communities identify strategies with the best available evidence. These strategies include teaching coping and problem-solving skills and promoting connectedness, identifying and supporting people already at risk, and creating protective environments and strengthening access and delivery of suicide care to prevent future risk.[28]

LIMITATIONS

This study has at least four notable limitations. First, a major limitation is the lack of mortality information. As previously noted, a systematic review reported an average 2% of patients died by suicide within 1 year of hospital-treated SII.[18] Second, this study's MarketScan data source lacked comprehensive data on patients' socioeconomic and race/ethnicity information. For example, previous research has reported a high proportion of patients hospitalized following a suicide attempt are white males and that SII mechanism is associated with

patient race/ethnicity.[29] Third, this study relied on administrative coding, which implies a number of limitations. Authors were limited to E-codes to identify self-harm intent on medical claims for injury treatment, and proposed criteria to use available administrative data (e.g., clinical setting, injury mechanism) to differentiate unique SII events. Authors' use of administrative data also did not facilitate investigation of a wide range of risk factors for repeat SII that have been investigated in survey studies, such as patients' familial relationships.[7]

The fourth limitation is that this study's 1-year follow-up period to observe repeat SII is shorter than previous studies using hospital-based registry data in other countries. For example, over a 7-year study period, 22% of SII patients presented on at least two occasions to EDs in Ireland, 10% presented at least three times, and 1% presented at least ten times.[12] However, nearly half of those observed repeat injuries occurred within 3 months of the index SII and almost two thirds occurred within 6 months, suggesting that the 1-year observation period employed in this study may capture the majority of patients that repeat SII.[12]

CONCLUSIONS

This study described SII and repeat SII among a large sample of U.S. youth during a period in which prevalence of youth SII increased substantially, according to population-based ED visit data in the U.S. and other countries. This study reported that just half of youth with clinically treated SII were seen in an ED and that 11% of patients sought clinical treatment for repeat SII within 1 year. Notably, 70% of youth with clinically treated SII were seen by a clinician for comorbidities in the 12 months prior to SII treatment. Such information on health care provider contacts with youth patients at risk of SII may be used to target prevention and treatment activities. Beyond identifying at-risk patients, clinical and public health decision making will benefit from widespread implementation of evidence-based primary prevention strategies, further implementation of proven approaches, and identification of new strategies for SII, that, together, will ultimately help to prevent suicide.

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SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at https://doi.org/10.1016/j.amepre.2018.09.009.

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