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RESEARCH ARTICLE

Self-Directed Violence After Medical Emergency Department Visits Among Youth

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Introduction: Identifying medical encounters that precede self-directed violence may allow for important prevention opportunities. This study examined the risk of self-directed violence after visiting the emergency department for a range of physical health conditions among youth.

Methods: This retrospective cohort study used 2012−2013 statewide emergency department data from six states. Among patients aged 15−29 years, the exposure group included 2,192,322 emergency department visits for 16 selected conditions, coded by whether visits for those conditions were the first, second, or third or later visit for that condition. Emergency department visits for a minor infection served as the reference group (n=149,163). A Cox proportional hazard model was used to assess the risk of a self-directed violence event within 6 months for each condition. Analyses were conducted in 2017.

Results: Overall, 8,489 (0.4%) of all patients visited the emergency department for self-directed violence over a 6-month period. Initial visits for epilepsy or seizures conveyed a markedly elevated hazard ratio for subsequent self-directed violence at 6.0 and 5.7, respectively (p<0.001). Initial visits for other conditions showed moderately elevated risk with hazard ratios primarily <2. Second visits for various pain symptoms, syncope, vomiting, or non−self-directed violence injury also had a 3- to 5-fold increase in hazard ratios for subsequent self-directed violence. Hazard ratios for third or later visit increased to 8.8 for back pain, 6.9 for headache, about 5 for abdominal pain, dental complaints, and non−self-directed violence injury (p<0.001).

Conclusions: Young people presenting to the emergency department for certain medical conditions are at an increased risk of subsequent self-directed violence. An awareness of these patterns may help guide screening efforts for suicide prevention in clinical settings.

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INTRODUCTION

Suicide is the second leading cause of death among youth and young adults in the U.S.,[1] with suicide rates rising since 1999.[2,3] Suicide is a serious public health problem, but can be prevented through comprehensive strategies.[4−8] Healthcare settings, especially emergency departments (EDs), play a critical role in suicide prevention, given that approximately 40% of suicide decedents aged 16 years and older visit an ED during the year before their death.[9−11] Better understanding the nature of ED visits preceding suicidal behavior could help guide ED-based screening and prevention strategies.

Mental disorders and substance use disorder are two major risk factors for suicide.[12] Thus, healthcare

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professionals may be prompted to assess for suicide risk when patients visit the ED for these conditions.[13] However, individuals with suicidal ideation often present at the ED for physical reasons without disclosing their mental health state.[10,11,14] Ahmedani et al.[10] found that among suicide decedents who visited EDs in the year prior to their death, about 60% did not have a mental health or substance use diagnosis. In cases like these, there is a paucity of data to guide clinical practice. The risk of suicide associated with patients' stated physical health conditions resulting in ED visits has not been thoroughly assessed. Although some physical health conditions, such as abdominal pain, chest pain, syncope, seizure, epilepsy, and asthma, have been found more common among self-harm cases than among controls for hospitalized young adults in Sweden,[15] these conclusions were based on crude percentages and did not adjust for covariates, such as mental disorders. Kvaran and colleagues[16] demonstrated an increased risk for suicide as the total number of ED visits increased for all ages, but did not examine the risk by individual conditions. Gaps remain in understanding how ED visits for physical health conditions relate to later risk for suicide and how such information may inform screening or prevention service delivery.

About a third of suicides are preceded by suicide attempts.[17–19] Self-directed violence (SDV),[20] which may or may not involve intent to die, is the strongest predictor of suicide, associated with a 10- to 60-fold increased risk for suicide death among youth.[21–24] Further, SDV itself may result in a broad range of morbidities[25,26] and disability.[27] In particular, individuals aged 15–29 years experience the highest ED visit rates for SDV.[28] To better examine the elevated risk for SDV in young patients presenting to the ED with medical chief complaints, this study examines the subsequent risk of SDV for physical health reasons to visit ED, stratified by the sequence of visit (i.e., first, second, third or later visit), among patients aged 15–29 years.

METHODS

Study Sample

To assemble the sample for this retrospective cohort study using statewide ED data from six states, patients with ED visits for various physical health conditions of interest were identified. Then these patients were followed until an SDV event, death, or the study endpoint. The physical health condition listed as the primary diagnosis at the most recent ED visit served as the main exposure, and was categorized as being the first, second, or third or later visit for that condition. As a comparator of people who present with more minor conditions, those individuals whose most recent ED visits were for a minor infection served as the reference group. This study used publicly available de-identified data and was exempted from IRB review. All analyses were conducted in 2017.

Data for six states were obtained from the 2011–2013 State Emergency Department Databases (SEDD) and State Inpatient Databases (SID), sponsored by the Agency for Healthcare Research and Quality.[29,30] These data contain clinical and nonclinical information for all visits of all payers to hospital-based EDs in the state. SEDD captures ED encounters that are not admitted, whereas SID captures those that are admitted. Data from Florida, New York, Nebraska, Vermont, Iowa, and Massachusetts were analyzed as these states had a high percentage (>75%) of verified patient linkage numbers, allowing visits by the same person to be linked across years.

Measures

To assemble the study's cohort, individuals experiencing an ED visit for various physical health conditions were identified and then followed until they experienced an SDV event, death, or the study endpoint (December 31, 2013), whichever occurred first during 2012–2013. An ED visit was considered as occurring for physical health conditions if the primary diagnosis was not for a mental health disorder (ICD-9-CM 290–319). Because a person may have multiple ED visits for physical health conditions during the study period, the most recent visit before an SDV event, death, or the study endpoint was selected as the index visit and treated as the study starting point for each individual.

By analyzing the primary diagnoses of those index visits for physical health conditions that were followed by an SDV event, the following 16 most common physical health conditions were selected to focus on: abdominal pain, headache, chest pain, joint pain/generalized pain, cellulitis, urinary tract infection, gastroenteritis/colitis, back pain, lower respiratory infection, syncope, dental complaints, vomiting, asthma, seizure, epilepsy, as well as injury (but without listing SDV as a cause of injury; Appendix Table 1, available online). Together, these diagnoses accounted for 63% of the index visits for physical health reasons preceding an SDV. The reference group comprised individuals whose index visit was for a minor infection (e.g., pharyngitis, tonsillitis, upper respiratory infection). The remaining medical diagnoses in the data set each individually accounted for <1% of the index visits for physical health reasons preceding an SDV and were collapsed into a miscellaneous category for which risk of SDV was not studied. Thus, the study cohort was composed of the index visits for the 16 physical health conditions and the reference group (Appendix Figure 1, available online).

To identify the sequence of visits, the number of visits for each physical health condition preceding the index visit and the total number of visits for any physical condition were counted for each individual. The physical health condition listed as the primary diagnosis at the index visit served as the primary exposure, which was treated as a categorical variable indicating the index visit as the first, second, or third or later visit for that condition (reference group coded as 0). For some medical conditions with small numbers for the third or later visit, the category for third or later was collapsed with second into second or later visits.

Each individual was followed to examine for the presence of an SDV event, death, or reaching the study endpoint (December 31, 2013). SDV events, including both ED visits and hospitalizations, were identified using ICD-9-CM code E950–E958 in the 2011

Table 1. Characteristics of ED Visits for Physical Health Conditions by Sequence of Visits

Characteristics	Reference,[a] % (*n*=149,163)	Exposure group (*n*=2,192,322)[a]		
		First visit, % (*n*=1,376,063)	Second visit, % (*n*=392,365)	Third or later visit, % (*n*=423,894)
Age, years[b]				
15–19	31.2	30.6	28.4	21.3
20–24	38.7	36.9	37.3	39.3
25–29	30.1	32.5	34.2	39.4
Females[b]	60.1	45.9	50.1	60.7
Race/ethnicity[b]				
White	43.9	53.5	50.7	48.5
Black	26.1	17.1	21.4	25.8
Other[c]	26.9	24.8	24.2	22.9
Missing	3.1	4.6	3.6	2.8
Type of insurance[b]				
Medicaid	35.3	19.1	29.0	42.5
Private	33.9	49.3	39.8	26.6
Uninsured	30.8	31.6	31.2	30.9
Missing	0.01	0.03	0.03	0.04
Listed a mental disorder at any visit[b,d]	15.5	10.5	20.8	39.4
Visited ED for a mental disorder[b,e]	2.3	1.1	2.9	7.7

[a]The reference group comprised individuals whose index visit was for a minor infection (e.g., pharyngitis, tonsillitis, upper respiratory infection). The exposure group comprised individuals whose index visit was for 1 of the 16 selected physical health conditions.
[b]$p<0.001$ for χ^2 test.
[c]Other race/ethnicity category included Hispanic, Asian or Pacific Islander, Native American, other race.
[d]Listed a mental disorder at any visit: listed a mental disorder (ICD-9-CM: 290–319) as the secondary diagnosis at any visit up to the index visit during 2012–2013.
[e]Visited ED for a mental disorder: listed a mental disorder (ICD-9-CM: 290–319) as the primary diagnosis at any ED visit before the index visit during 2012–2013.
ED, emergency department.

–2013 data. The case definition was complemented with a validated algorithm for identifying SDV.[31] As SDV behavior can be repetitive, the first SDV event in 2012–2013 was selected as the study outcome to examine. Individuals who engaged in SDV in 2011 were excluded to ensure that the ED visits for physical health conditions during 2012–2013 preceded SDV events; thus, the included individuals did not have an SDV event for at least >1 year before the index visit. To focus on short-term risk, only the risk of SDV within 6 months of the index visit was estimated.

Risk of SDV was assessed for each of the 16 conditions. Covariates adjusted for included age (15–19, 20–24, 25–29 years), sex, race/ethnicity (white, black, other including missing), and payer (Medicaid, private insurance, no insurance). Adjusted covariates also included a set of indicators on whether the person had visited for each of the other 15 conditions and miscellaneous conditions during 2012–2013. Presence of a mental disorder diagnosis at any visit up to the index visit was also adjusted for.

Statistical Analysis

Cox proportional hazard models were used to examine the hazard ratios (HRs) for SDV within 6 months of the index visit for each of the exposure conditions. HRs for mental disorders being the primary diagnosis at the index visit were not the interest in this study but were calculated to contrast the magnitude of risk for physical health conditions. A time interval variable was calculated as weeks between the index visit and a subsequent SDV event, death, or study endpoint. To allow time varying HRs, an interaction term between the condition X log of the interval was included.[32] When this interaction term was significant, only the HR at the first week was reported. The final models were determined through an automated best subset selection process based on Akaike information criteria.[33] All statistical analyses were conducted using SAS, version 9.1.3, with a two-sided α level of 0.05 for statistical significance.

RESULTS

Of 2,341,485 index ED visits included in the study cohort, 149,163 were in the reference group and 2,192,322 were in the exposure group, with 63% of the exposure group having a first visit, 18% a second visit, and 19% a third or later visit. Compared with the reference group, individuals with three or more visits were more likely to be older (25–29 years), white, Medicaid insured, and have a mental disorder (Table 1).

A total of 8,489 individuals (0.4%) among the study cohort visited the ED for SDV within the following 6 months. SDV rates increased with the number of visits for most physical health conditions (Appendix Table 2,

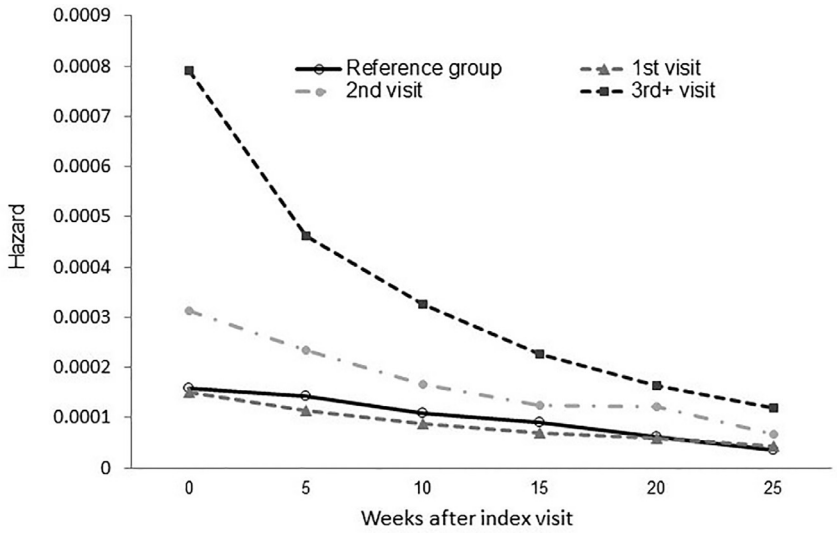

Figure 1. Hazard for self-directed violence over time for emergency department visits for physical health conditions by sequence of visits.

Note: The reference group comprised persons whose index visit was for a minor infection (e.g., pharyngitis, tonsillitis, upper respiratory infection).

available online). Half of the SDV events occurred within 42 days of the index visit. Among the first SDV events, 0.4% were fatal. Individuals experiencing an SDV event were more likely than those who did not to die for any cause during the study period (0.8% vs 0.05%, respectively).

Figure 1 shows the hazard of SDV over time by sequence of visits based on total number of visits for physical health conditions. For all categories, the hazard was the greatest immediately after the ED visit, especially for the third or later visit. The highest hazard was for the third or later visit, with the gap between this category and the reference group narrowing over time. The hazards over time for each individual condition vary (not shown).

The adjusted HRs of SDV for each medical condition are presented in Table 2 and Figure 2. When the index visit was the first visit for the given condition, patients with epilepsy and seizure had a 6.0-fold (95% CI=3.8, 9.6) and 5.7-fold (95% CI=3.6, 8.9) increased risk, respectively. A single visit for other physical health conditions showed moderately elevated risk with HRs primarily <2. For the second visit, patients with epilepsy and seizure continued to have a high risk at 8.4 (95% CI=4.0, 17.4) and 7.9 (95% CI=4.1, 15.1), respectively. The second visit for back pain showed an increased HR at 4.9 (95% CI=2.7, 8.8). In addition, the second visit for abdominal pain, headache, chest pain, joint pain/generalized pain, syncope, vomiting, or non-SDV injury had an elevated HR of 3- to 5-fold. The remaining physical health conditions exhibited relatively low risk with HRs <2. For the third or later visit, the risk of SDV for back pain increased to 8.8-fold (95% CI=4.8, 16.1). Increased HRs were also observed for headache (HR=6.9, 95% CI=4.2, 11.5), abdominal pain (HR=4.8, 95% CI=3.1, 7.5), dental complaints (HR=5.0, 95% CI=2.7, 9.1), and non-SDV injury (HR=4.6, 95% CI=3.5, 6.0). Although the third or later visit for epilepsy had a lower HR of 2-fold, the high risk for the first and second visit may warrant evaluation of SDV risk for these patients. Taken together, the group with the most heightened risk of SDV included any visit for epilepsy or seizure; second or later visits for back pain, headache, abdominal pain, chest pain, joint pain/generalized pain, syncope, vomiting, or non-SDV injury; and the third or later visit for dental complaints. Altogether, this group accounted for 24% of the youth and young adults with SDV events following an ED visit for physical health conditions.

As expected, preceding ED visits for mental disorders showed an increased risk of subsequent SDV within 6 months, with HRs of 6.6 (95% CI=5.1, 8.6), 13.0 (95% CI=9.8, 17.3), and 24.8 (95% CI=18.8, 32.7) for the first, second, and third or later visits, respectively (Table 2). Notably, the risk of SDV for any visit for seizure or epilepsy and the third or later visit for back pain and headache were approximately equivalent to the risk following a single visit for a mental disorder.

Significant negative parameters for time-varying effect were observed for HRs of the following conditions: any

Table 2. HRs for SDV by Physical Health Conditions and Sequence of Visits

Reasons to visit ED/ sequence of visits[a]	HR[b] (95% CI)	*p*-value	Parameter for the time-varying effect[c]
Abdominal pain			
First	2.0 (1.5, 2.7)	<**0.0001**	−0.18
Second	3.0 (2.0, 4.5)	<**0.0001**	−0.23
Third or later	4.8 (3.1, 7.5)	<**0.0001**	−0.42
Headache/migraine			
First	1.8 (1.3, 2.5)	<**0.001**	−0.14
Second	3.3 (1.9, 5.7)	<**0.0001**	−0.37
Third or later	6.9 (4.2, 11.5)	<**0.0001**	−0.49
Chest pain			
First	1.7 (1.2, 2.5)	<**0.01**	−0.18
Second or later	3.5 (2.0, 6.1)	<**0.0001**	−0.31
Joint pain/generalized pain			
First	1.5 (1.3, 1.7)	<**0.0001**	
Second or later	4.2 (2.6, 6.9)	<**0.0001**	−0.34
Cellulitis			
First	1.3 (1.1, 1.6)	<**0.01**	
Second	2.1 (1.6, 2.6)	<**0.0001**	
Third or later	2.3 (1.7, 3.2)	<**0.0001**	
Urinary tract infection			
First	1.3 (1.1, 1.6)	<**0.001**	
Second or later	1.8 (1.3, 2.4)	<**0.001**	
Gastroenteritis/colitis			
First	1.8 (1.2, 2.5)	<**0.01**	−0.16
Second or later	1.3 (0.9, 2.1)	0.2	
Back pain			
First	2.2 (1.6, 3.2)	<**0.0001**	−0.21
Second	4.9 (2.7, 8.8)	<**0.0001**	−0.59
Third or later	8.8 (4.8, 16.1)	<**0.0001**	−0.77
Acute bronchitis and bronchiolitis/pneumonia			
First	1.3 (1.1, 1.6)	<**0.01**	
Second or later	1.5 (1.0, 2.3)	**0.04**	
Syncope			
First	2.4 (1.7, 3.3)	<**0.0001**	−0.23
Second or later	3.6 (1.7, 7.7)	**0.001**	−0.39
Dental disorders			
First	1.3 (1.1, 1.5)	**0.01**	
Second	1.8 (1.3, 2.5)	**0.001**	
Third or later	5.0 (2.7, 9.1)	<**0.0001**	−0.62
Vomiting			
First	1.5 (1.2, 1.8)	<**0.0001**	
Second or later	3.6 (1.8, 7.1)	<**0.001**	−0.59
Asthma			
First	1.4 (1.1, 1.7)	<**0.01**	
Second or later	1.6 (1.2, 2.2)	<**0.01**	
Seizure			
First	5.7 (3.6, 8.9)	<**0.0001**	−0.38
Second or later	7.9 (4.1, 15.1)	<**0.0001**	−0.58
Epilepsy			
First	6.0 (3.8, 9.6)	<**0.0001**	−0.29

(*continued on next page*)

Table 2. HRs for SDV by Physical Health Conditions and Sequence of Visits (*continued*)

Reasons to visit ED/ sequence of visits[a]	HR[b] (95% CI)	*p*-value	Parameter for the time-varying effect[c]
Second	8.4 (4.0, 17.4)	<**0.0001**	−0.59
Third or later	2.0 (1.1, 3.7)	**0.02**	
Non-SDV injury			
First	1.9 (1.5, 2.4)	<**0.0001**	−0.18
Second	3.3 (2.6, 4.3)	<**0.0001**	−0.3
Third or later	4.6 (3.5, 6.0)	<**0.0001**	−0.28
Mental disorders[d]			
First	6.6 (5.1, 8.6)	<**0.0001**	−0.43
Second	13.0 (9.8, 17.3)	<**0.0001**	−0.39
Third or later	24.8 (18.8, 32.7)	<**0.0001**	−0.51

Note: Boldface indicates statistical significance ($p<0.05$).
[a]For some physical health conditions, due to a small number of cases for the third or later visit, the category for third or later was collapsed into second or later.
[b]The reference group comprised individuals whose index visit was for a minor infection (e.g., pharyngitis, tonsillitis, upper respiratory infection). The HR model for each main condition of interest was adjusted for covariates including age, sex, race/ethnicity, payer, whether visited ED for each of the other 15 physical health conditions, and miscellaneous physical health conditions. Also adjusted for presence of a mental disorder using two variables: visited ED for a mental disorder (with a mental disorder being the primary diagnosis) before the index visit, and listed a mental disorder (with a mental disorder being a secondary diagnosis) at any visit before the index visit during the study period. The covariates in the final models were determined by automatic best subset selection process. Time varying effect of HRs were assessed by including an interaction term between the condition and log of the interval.
[c]Only presented for the conditions with significant time-varying effect based on $p<0.1$. This column was blank for the conditions that had no significant time-varying effect.
[d]Risks of SDV for mental disorders were presented to contrast the risks for the physical health conditions.
ED, emergency department; HR, hazard ratio; SDV, self-directed violence.

visits for seizure, back pain, abdominal pain, chest pain, headache, syncope, non-SDV injury, first and second visit for epilepsy, first visit for gastroenteritis, second visit for joint pain/generalized pain and vomiting, and third or later visit for dental complaints, implying that the HRs were the highest within the first week following an ED visit for these conditions (Table 2).

DISCUSSION

Overall, 0.4% of individuals who presented to an ED for physical health conditions subsequently visited an ED for SDV within 6 months. The most frequent physical health conditions found associated with heightened risk for SDV included: any ED visit for epilepsy or seizure; two or more visits for symptoms including various pain conditions, syncope, vomiting, or non-SDV injury; or three or more visits for dental complaints. Meanwhile, individuals who visited the ED for explicit diagnoses, such as cellulitis, urinary tract infection, gastroenteritis/colitis, lower respiratory infection, and asthma, had only modest risk for a subsequent SDV event, suggesting that ED visits for these conditions may not serve as a sensitive indicator for SDV risk.

Importantly, half of SDV events following an ED visit occurred within 42 days of the index visit. The heightened risk of SDV following visits for medical conditions suggests that ED settings may serve as a critical window of opportunity for detection and intervention of individuals at risk of SDV. Recent research has demonstrated promise in the use of clinical data to identify patients at increased risk of suicide using automated approaches, which may assist busy clinicians in better serving at-risk populations.[34,35] The health conditions studied may inform variable selection for such models.

The groups identified herein with heightened risk for SDV are consistent with the limited extant literature. Both epilepsy and seizure previously have been identified as risk factors for suicide.[36–38] Various types of pain have also been reported to be associated with suicidal behaviors.[39–47] The etiology of the influence of pain on SDV is complex. Common mental disorders have been found to be mediators but did not completely explain the association.[48] In addition, research also suggests that some people suffering from chronic physical pain may attempt suicide to seek relief when they feel the pain is unbearable.[49] Likewise, Poulin et al.[50] found that inability to cope with pain was a primary reason to visit the ED among a group of patients who presented at an ED for chronic pain. Thus, ED visits for pain may signal that the patient's pain is unmanageable and may suggest a higher risk of SDV. As prior studies have also indicated, patients who visited the ED for dental complaints were more likely to be uninsured or Medicaid

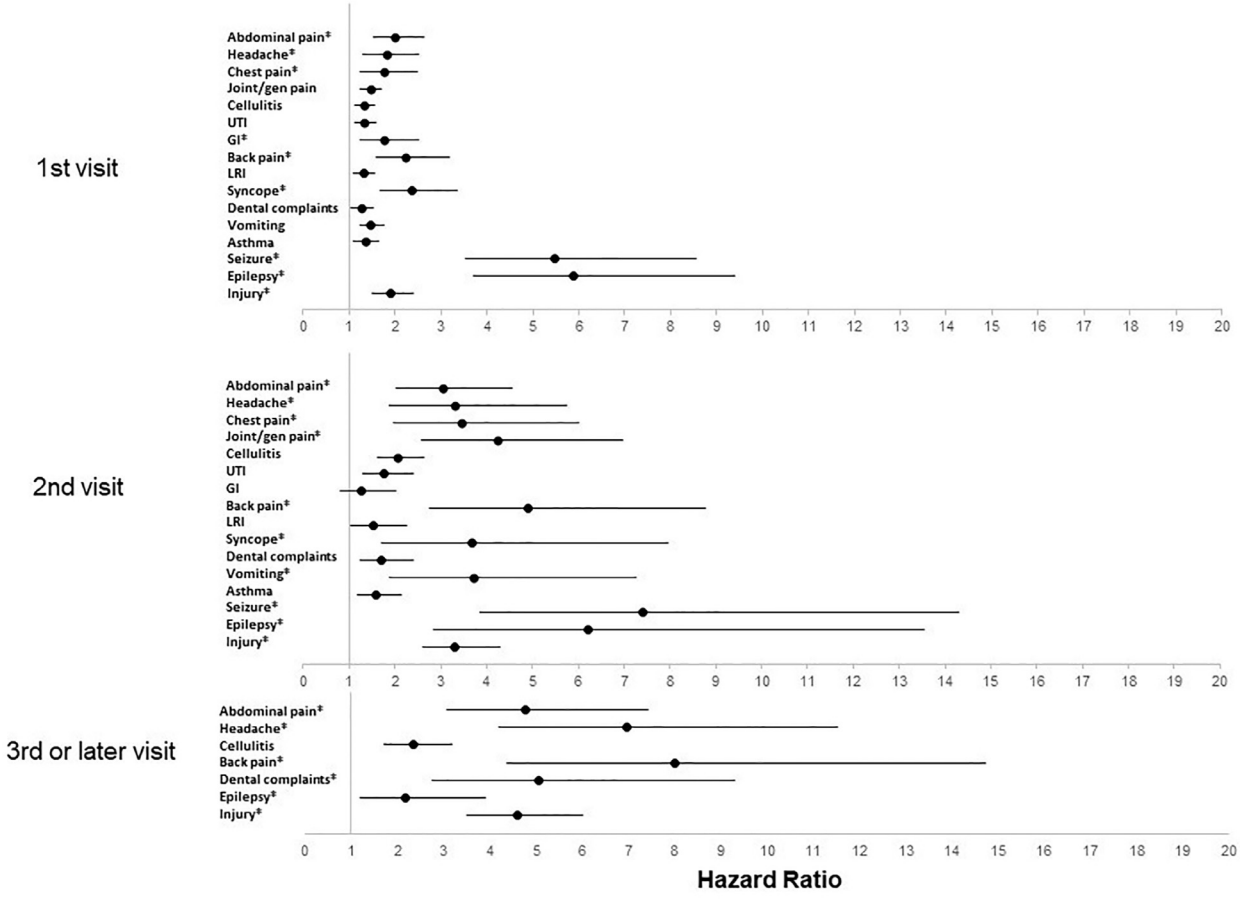

Figure 2. Adjusted HRs for self-directed violence by physical health condition treated in the ED and sequence of visits.
Note: The dots indicate HRs and the lines indicate the 95% CIs. For some physical health conditions, due to a small number of cases for the third or later visit, the category for third or later was collapsed into second or later. The reference group comprised individuals whose index visit was for a minor infection (e.g., pharyngitis, tonsillitis, upper respiratory infection). The hazard ratio model for each main condition of interest was adjusted for covariates including age, sex, race/ethnicity, payer, whether visited ED for each of the other 15 physical health conditions, and miscellaneous physical health conditions. Also adjusted for presence of a mental disorder using two variables: visited ED for a mental disorder (with a mental disorder being the primary diagnosis) before the index visit, and listed a mental disorder (with a mental disorder being a secondary diagnosis) at any visit before the index visit during the study period. The covariates in the final models were determined by automatic best subset selection process. Time varying effect of HRs were assessed by including an interaction term between the condition and log of the interval.
*Indicates significant time-varying effect; HRs were reported for the first week after the index visit for the condition.
ED, emergency department; GI, gastroenteritis/colitis; HR, hazard ratio; LRI, acute bronchitis and bronchiolitis/pneumonia; UTI, urinary tract infection.

insured,[51,52] implying that SES may play a role in the association of dental complaints and SDV. Nevertheless, the HR for the third or later visits for dental complaints remained high after adjusting for race and insurance status in the current study. Another possible explanation for increased SDV risk following pain-related ED visits is that some patients might present with pain as a result of opioid use disorder,[53] a known risk factor for suicide.[12] Regardless of the underlying reason for ED presentation for pain, the current study demonstrates that those presenting in EDs for pain are at elevated risk for subsequent SDV. These findings can serve to increase ED clinicians' awareness of the potential risk for suicide among this group of patients and highlight the need for psychosocial intervention when appropriate.[54]

Limitations

This study possesses several limitations. First, SDV events were identified based on ED visits or hospitalizations. About 70% of people who engage in SDV do not seek medical assistance,[55] and therefore are not able to be included. Second, conditions of interest were identified based on ICD-9-CM codes, which may result in underreporting of SDV and mental disorders. Similarly,

some non-SDV injuries may actually be SDV episodes but are incorrectly classified, which may inflate the association of preceding injury with subsequent SDV. Third, Healthcare Cost and Utilization Project data only include community hospitals; SDV treated at non-community hospitals (e.g., federal hospitals, psychiatric hospitals) were not included. However, community hospitals are the primary source of treatment for psychiatric patients in the U.S.[56] Fourth, people who sought care out-of-state were not included in the SEDD and SID of the included states, potentially leading to some misclassification bias if not all ED visits could be accounted for. Fifth, although the study included six states that are geographically dispersed and have varied suicide rates, the results may not be generalizable to other states. Finally, the reference group may not perfectly represent the healthy general population, as all individuals did visit the ED for some condition, however minor. Nonetheless, this population would likely have increased risk of SDV compared with the general population, thereby biasing HRs toward the null.

CONCLUSIONS

This study provides detailed insight on the increased risk of SDV that patients visiting the ED for medical complaints subsequently experience, which underscores the importance of EDs in suicide prevention. The broad number of physical health conditions associated with an increased risk of SDV may serve to support expanded or broader screening for SDV risk in EDs. It is important to note that effective primary prevention of suicide should also include efforts outside of clinical settings.[5] Nonetheless, this study helps elucidate the important opportunities that exist to identify patients who could benefit from further intervention.

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The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the CDC.

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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.2018.09.014.

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