

# Assessing Risk of Future Suicidality in Emergency Department Patients

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## ABSTRACT

**Background:** Emergency departments (ED) are the first line of evaluation for patients at risk and in crisis, with or without overt suicidality (ideation, attempts). Currently employed triage and assessments methods miss some of the individuals who subsequently become suicidal. The Convergent Functional Information for Suicidality (CFI-S) 22-item checklist of risk factors, which does not ask directly about suicidal ideation, has demonstrated good predictive ability for suicidality in previous studies in psychiatric patients but has not been tested in the real-world setting of EDs.

**Methods:** We administered CFI-S prospectively to a convenience sample of consecutive ED patients. Patients were also asked at triage about suicidal thoughts or intentions per standard ED suicide clinical screening (SCS), and the treating ED physician was asked to fill a physician gestalt visual analog scale (VAS) for likelihood of future suicidality spectrum events (SSE; ideation, preparatory acts, attempts, completed suicide). We performed structured chart review and telephone follow-up at 6 months post-index visit.

**Results:** The median time to complete the CFI-S was 3 minutes (first to third quartile = 3–6 minutes). Of the 338 patients enrolled, 45 (13.3%) were positive on the initial SCS, and 32 (9.5%) experienced a SSE in the 6 months of follow-up. Overall, SCS had modest diagnostic accuracy sensitivity 14/32 = 44%, (95% CI: 26–62%) and specificity 275/306 = 90%, (86–93%). The physician VAS also had moderate overall diagnostic accuracy (AUC 0.75, confidence interval [CI] = 0.66–0.85), and the CFI-S was best (AUC = 0.81, CI = 0.76–0.87). The top CFI-S differentiating items were psychiatric illness, perceived uselessness, and social isolation.

**Conclusions:** Using CFI-S, or some of its items, in busy EDs may help improve the detection of patients at high risk for future suicidality.

With more than 4 million visits to the ED annually in the United States for mental disorders, the ED is considered by many to be the first line of evaluation for patients at risk and in crisis, with or without overt suicidality (ideation, attempts).<sup>1</sup> The weighted national estimate of patients with a diagnosis

of “suicide or intentional self-harm” in the National Emergency Department Sample for 2013 was 1,411,770, patients, with 98.8% of those with suicidality as a first diagnosis discharged from the ED. In 2013, visits for suicidal ideation accounted for nearly 1% of all adult ED visits (108.3 million visits).<sup>2</sup>

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To better predict and prevent suicides, emergency care providers need improved risk stratification tools for patients with overt or covert mental health crisis. Several tools—PHQ9<sup>3</sup>, the ED-Safe Patient Safety Screener<sup>4</sup> and the Suicide Behaviors Questionnaire–Revised (SBQ-R)<sup>5</sup>—have been created and validated for suicide screening. All of these include direct questioning about current or recent suicidal thoughts. None of these tools has been compared to physician gestalt or evaluated for their ability to predict rates of adverse suicide-related events in patients who screen negative using the tool. There are yet no widespread clinically used simple objective tools to assess and track changes in suicidal risk without asking the individuals directly, although others in the field besides us are actively working on this problem and progress is being made (for example Nock and colleagues,<sup>6,7</sup> Boudreaux and colleagues<sup>8–10</sup>). Such tools are desperately needed, as individuals at risk may choose not to share their ideation or intent with others, for fear of stigma or hospitalization or that in fact their plans may be thwarted.

The Convergent Functional Information for Suicidality (CFI-S) is a novel suicide risk instrument that comprises 22 questions and has shown good to excellent predictive value for suicidality in settings other than the emergency department (ED).<sup>11–13</sup> The CFI-S is a checklist of risk factors for suicidality from a variety of domains including life satisfaction, mental health, physical health, environmental stress, addictions, cultural factors, and demographic information and assigns a numeric point value for each response, 0 for absent or 1 for present. In essence, it is a “polyphenic” risk score, by analogy with polygenic risk scores. The tool was designed to be easy to score by self-administration or clinician administration or based on medical records or next-of-kin information. Of note, it does not ask directly about suicidal ideation, as that is a delicate question in many nonspecialized settings, and people who are truly suicidal might not share that information for fear of being stopped.

We hypothesized that the CFI-S could be used in a heterogeneous sample of ED patients to identify high-risk patients whose elevated risk was missed by both standard screening and by physician evaluation as measured by their gestalt impression of future risk.

We sought to test the accuracy of the CFI-S and physician gestalt visual analog scale (VAS) in a sample of urban ED patients, with a traditionally high proportion of non-Caucasians and low-income individuals.

The reason for this is this population has a higher-than-average risk of suicidality<sup>14</sup> but with the lowest access to mental health services.<sup>15</sup> Thus, in this population, the need for accurate suicide risk assessment is compounded by the lack of current identification of nonovert suicidal ideation and the need for pragmatic use of limited resources.

## METHODS

This study received approval from the Indiana University School of Medicine Institutional Review Board and all patients completed a written informed consent process before participation. Patients were eligible for inclusion if they were over 18 and were able to participate in the survey. Exclusion criteria included age less than 18, severe trauma or illness requiring emergent intervention, or acute intoxication as reported by the clinical staff or patient. Patients were enrolled in the ED of the Sydney and Lois Eskenazi Hospital, an urban safety net hospital that has an annual volume of 95,000 visits. Between March 2016 and April 2017 the CFI-S was prospectively administered to a sample of 338 ED patients. The patients were consecutive and nonselected, meaning the research staff enrolled patients one after the other without interruption and without regard to the chief complaint. Research staff approached patients after their initial nursing and physician assessments were complete. They administered the CFI-S asking subjects for yes or no answers to all questions, documenting start and end times of the survey. Questions were asked exactly as written and requests for clarification from patients responded to with “please answer the question as you understand it.” Each answer of yes resulted in one point. The final CFI-S score is calculated by dividing the total number of affirmative answers by the total number of questions answered.

After the CFI-S was completed, research staff also approached the patient’s ED physician (board-certified emergency physicians or emergency medicine residents in training) to obtain their physician clinical gestalt VAS regarding the patient’s risk of future suicide-related outcomes over the following 6 months. Physicians were asked to assess their numeric probability (0%–100%) that the patient would have a suicidality spectrum event (SSE), defined as repeat ED visit or admission for suicidal ideation, preparatory acts, suicide attempts, aborted or interrupted attempts, or completed suicide in the 6 months following the patient’s

index ED visit. This spectrum of severity approach is substantiated by our previous blood biomarker studies<sup>12,13</sup> and is supportive of suicidality as its own free-standing diagnosis, per the proposal of Oquendo and colleagues.<sup>16</sup> Physician gestalt VAS was obtained by clinicians making a vertical hash mark with a pen on a 10-cm horizontal line with 0 cm equaling 0% probability of suicide and 10 cm representing 100% probability. Research assistants also recorded subjects' responses to the health system's standard two-question universal screening tool. This screen includes the questions: "Do you have any thoughts of hurting yourself or anyone else?" and "Do you feel hopeless or helpless?" An affirmative response to either question is considered a positive screen in the health system but only those answering yes to the first question were coded as positive suicide screen for the purposes of our analysis. Patients were followed prospectively for SSEs. Members of the research team, who were trained by the principal investigators, performed structured telephone and chart review follow-up on all patients 6 months post-index visit. For follow-up, study personnel dialed the telephone number that patients directly stated as the best way to contact them. The number was dialed at least three times on different days at different times of day. After 6 months, we also queried the CareWeb electronic interface to the Indiana Network for Patient Care (INPC) system for a suicidal event. The INPC represents over 100 separate healthcare entities in Indiana providing data including hospitals, health networks, and insurance providers. Chart reviewers were trained study personnel who individually read and considered any documented medical encounter for specific words suggesting a suicidal event. Ambiguous cases were resolved by consensus between two authors.

We treated the suicide clinical screening (SCS), VAS, and CFIS as diagnostic tests with the primary outcome as SSE by 6 months. This work was done in accordance with the STARD guidelines for a diagnostic study.<sup>17</sup> Specifically, assessors of the primary outcome were blinded to the diagnostic test data.

Data were entered in REDcap and transferred to a spreadsheet for analysis. All data was z-scored by sex, to eliminate potential sex effects in the combined analysis. Diagnostic accuracy was assessed by  $2 \times 2$  contingency table analysis to generate point estimates of sensitivity and specificity as well as the area under the receiver operating characteristic (ROC) curve with associated 95% confidence intervals (CIs) for each index.

We compared areas under the receiver operating characteristic curve (ROC AUC) for gestalt VAS versus the CFIS using the method of Hanley and McNeil.<sup>18</sup> The optimal cutoff was chosen as the point on the ROC curve that conferred the peak diagnostic odds ratio (OR), defined as the maximal likelihood ratio positive/likelihood ratio negative.<sup>19</sup> Statistical analyses were performed with StatsDirect statistical software (v.3.0.187) and plots were made with as performed using GraphPad Prism version 7.00 for Windows.

## RESULTS

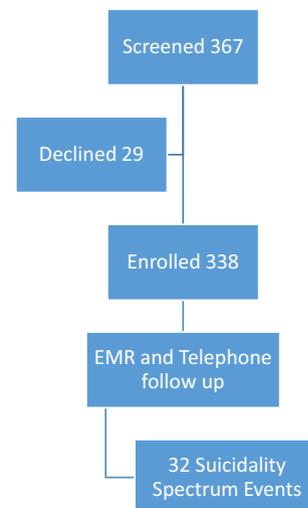
As shown in Figure 1, we approached 367 patients, and 338 (92%) agreed to participate. Physician clinical gestalt VAS data were collected on 170 subjects.

### Survey Characteristics

The median time to complete the CFIS was 3 minutes (first to third quartile = 3–6 minutes). Two research personnel, blinded to each other's results, administered the CFIS twice to 10 patients approximately 1 hour apart and found that the repeated values were within 10% of the first value in eight of 10 retests. The internal consistency of the CFIS was good, as reflected by the Cronbach's alpha of reliability of 0.84 (95% lower confidence limit = 0.81). Data were missing for one or more questions in 56 (16%) of the surveys.

### Patient Outcomes and Predictive Characteristics

Of the 338 patients, 32 (9.5%) experienced a SSE in the 6 months of follow-up. Table 1 outlines the



**Figure 1.** Flow diagram of research subjects. Number of patients approached and enrolled and with completed follow-up.

**Table 1**  
Demographic Information

	Positive SSE Outcome	Negative SSE Outcome
Number	32	306
Age (years), mean (IQR)	39 (30–51)	44 (31–54)
Sex (%)		
Male	59.4	47.4
Female	40.6	52.6
Race/ethnicity (%)		
White, non-Hispanic	44.7	39.1
White, Hispanic	6.4	2.4
Black, non-Hispanic	34.0	28.9
Asian, non-Hispanic	0.0	0.7
Not available	14.9	28.9

Demographic characteristics of patients who experienced a SSE in 180-day follow-up and those who did not.

**Table 2**  
SSEs That Occurred in the 6 Months Following the Original ED Visit

	Number (%)
Total patients	32
Suicide attempt	10 (31.3)
Psychiatric hospitalization for suicidality	16 (50.0)
Aborted/interrupted attempt	11 (34.4)
Preparatory acts	13 (40.6)
ED visit for suicidal thoughts	29 (90.1)

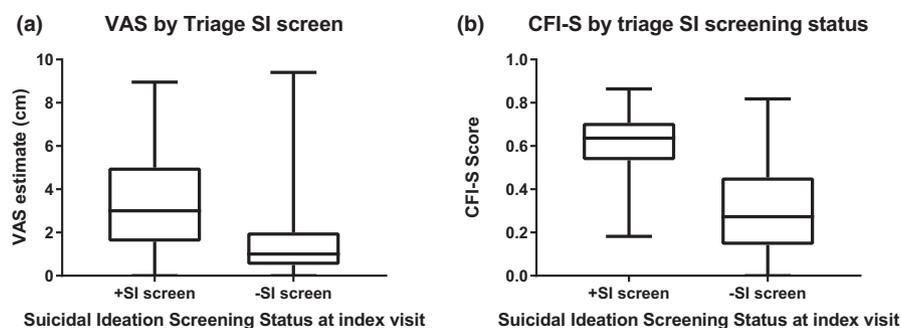
SSEs = suicide spectrum events.

demographics of our sample. The median age of those who experienced an SSE outcome was 39 (interquartile range [IQR] = 30–51) versus 44 (IQR = 31–54) in those who did not. ED revisits and psychiatric hospitalizations were the most common outcomes. Completed suicides did not occur in our sample in the 6-month follow-up (Table 2).

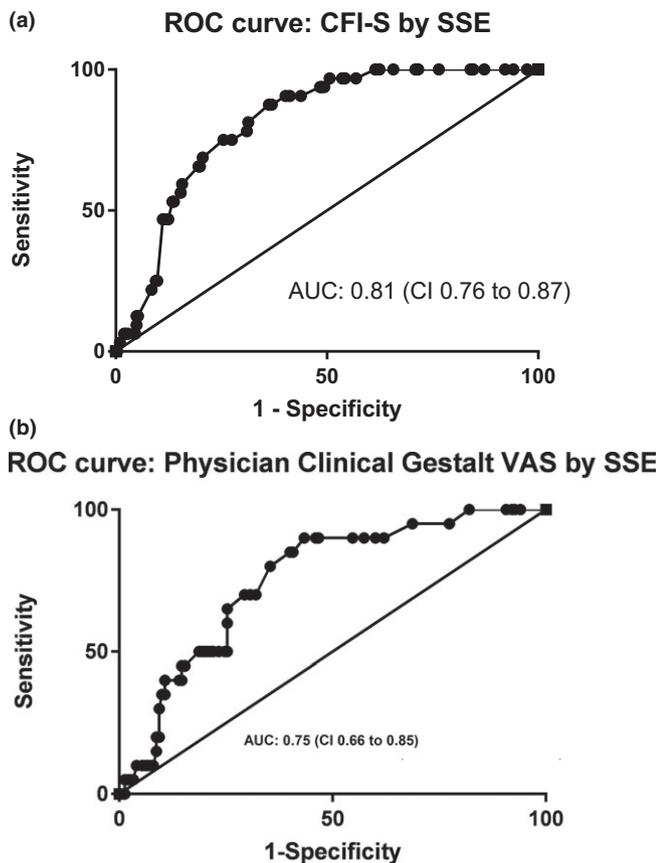
Of the 32 subjects who experienced a suicide-related outcome, 18 (56.3%) were not suicidal at first presentation as measured by the health system's standard two-question universal screening tool. This screen includes the questions "Do you have any thoughts of hurting yourself or anyone else?" and "Do you feel hopeless or helpless?" For study purposes a positive screen required the first question to be answered affirmatively although anyone answering the second question affirmatively did have additional ED assessment for thoughts of self-harm per screening hospital protocol.

Figures 2–4 examine predictive ability of VAS, and CFI-S for future SSEs. Figure 2 shows box plots with 1st–3rd quartiles and visually highlights the expected finding that VAS and CFI-S values tended to be higher in patients identified as having SI by standard clinical screening (SCS). Figure 3 compares the ROC for the CFI-S with the VAS. Physician VAS shows a higher ability to discriminate with an AUC of 0.75 ( $p = 1.27 \times 10^{-4}$ ). CFI-S had the highest numeric AUC of 0.81 ( $p = 5.11 \times 10^{-9}$ ). The optimal cutoff for physician VAS was 1.2 and for the CFI-S was 0.65. Figure 4 plots the first order regression between the CFI-S and VAS and shows moderate correlation (Pearson's  $r = 0.42$ ). Comparing the AUCs for physician VAS versus the CFI-S using the method of Hanley and McNeil first required restriction of data to patients with both values recorded, yielding 20 patients with SSE positive and 150 patients with SSE negative. The AUCs for this restricted data set were 0.77 (SEM = 0.04) for the CFI-S and 0.75 (SEM = 0.05) for the physician VAS yielding  $Z = 0.585$  and  $P = 0.558$ .

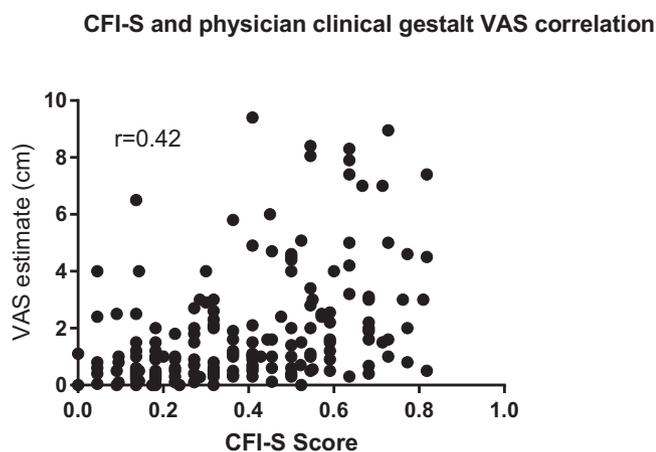
Table 3 shows the individual items of the CFI-S that were most able to differentiate between SSE and non-SSE. The top items are history of psychiatric



**Figure 2.** CFI-S, physician gestalt VAS, and SI screening. Comparison of the median (IQR) for the CFI-S scores and physician gestalt VAS for patient who screened positive for suicidal thoughts in triage compared to those who did not. CFI-S = Convergent Functional Information for Suicidality; SI = suicidal ideation; VAS = visual analog scale.



**Figure 3.** ROC curve analysis for the CFI-S and physician gestalt for the criterion standard outcome of a SSE in the 6 months following the index ED visit. AUC = area under the curve; ROC = receiver operating characteristic; SSE = suicide spectrum event; VAS = visual analog scale.



**Figure 4.** CFI-S and physician clinical gestalt VAS correlation. The two measures are correlated. The CFI-S identifies as high risk patients that are not identified as such by the physician's gestalt VAS. CFI-S = Convergent Functional Information for Suicidality; VAS = visual analog scale.

illness, perceived uselessness, and social isolation. Prediction results in all, by sex, and by items are summarized in Supplementary Information Tables S1–S3.

## DISCUSSION

In this sample of 338 consecutive ED patients, we found the current two question universal screen for suicidal intent failed to identify 18 (56.2%) patients who went on to have a SSE within 180 days. Those 18 patients represent 5.3% of our overall sample of unselected ED patients presenting for a wide variety of chief complaints. While several studies have found a high rate of undiagnosed depression in unselected patients,<sup>20</sup> to our knowledge, this is the first study to use a tool to predict suicidality in an unselected ED cohort. According to CDC data, an estimated 1.3 million adults aged 18 or older (0.6%) attempted suicide in the past year,<sup>21</sup> and 43% of patients who complete suicide visit an ED at least once in the year prior to their death.<sup>22</sup>

Given the increased risk of ED patients and the relative insensitivity of universal screening, we were interested if emergency physician clinical gestalt VAS would be a better diagnostic tool to predict suicidal events. To our knowledge, this is the first study to assess the diagnostic properties of physicians' clinical gestalt VAS for suicide-related outcomes in the general ED population. Unfortunately, physician gestalt for adverse suicide-related outcomes as measured by VAS shows only moderate diagnostic discrimination. In our experience ED physicians rely heavily on their clinical gestalt in combination with patients' responses to direct questioning about suicidal thoughts or plans. Given the limited diagnostic ability of both of these tools, data from Table 3 provide a preliminary inference that emergency physicians could use the three most sensitive questions from the CFI-S (prior mental illness/feelings of uselessness/social isolation) to improve our ability to detect future risk of suicidal behavior.

In addition to incorporating better risk assessments into our clinical assessment of SCS-standard clinical screening suicidal risk, making a significant impact on morbidity and mortality related to undiagnosed suicidality will require the development and broad implementation of brief, structured risk assessment tools that obviate the need for patients' to endorse directly present or recent suicidal thoughts. We found that the CFI-S can be given quickly and effectively, in the ED setting, is an accurate predictor of adverse suicide-related outcomes and avoids relying on patients' self-report of current or recent suicidal thoughts. The CFI-S took 3 minutes to complete, which although longer

**Table 3**  
CFI-S Individual Items Sensitivity and Specificity for SSE in the 6 Months of Follow-up

CFI-S Question	No. (%) Answering Yes	Sensitivity (%)	Specificity (%)
Q1. History of mental illness	151 (44.7)	96.8	40.3
Q2. Do you have poor compliance (i.e., not taking medications or keeping doctor's appointments)?	95 (28.1)	50.0	31.6
Q3. Do you have a family history of suicide or suicide attempts in blood relatives?	78 (23.1)	46.6	21.3
Q4. Do you personally know somebody who has committed suicide?	143 (42.3)	75.0	39.7
Q5. CSF-5: Do you have a history of abuse physical, sexual, emotional, or neglect?	130 (38.5)	62.5	36.5
Q6. Have you had an acute/severe medical illness, including acute pain ('I just can't stand this pain anymore.') within last 3 months?	153 (45.3)	43.8	45.7
Q7. Have you experienced acute stress within last 3 months (a major financial, professional, or personal loss or loss/death of a loved one)?	198 (58.6)	80.6	57.1
Q8. Have you experienced chronic feelings of uselessness or being a burden to your friends and/or family?	146 (43.2)	87.5	38.9
Q9. Do you have a history of introversion (keeping to yourself being a loner) and overconscientiousness (obsessive), such as planning minute details or being highly organized?	147 (43.5)	59.4	43.5
Q10. Are you dissatisfied with how life turned out for you?	118 (34.9)	73.3	32.7
Q11. Do you feel hopeless about the future?	84 (24.9)	64.5	22.1
Q12. Are you currently abusing substances (drugs, alcohol, medications, painkillers)?	83 (24.6)	40.6	23.1
Q13. Have you attempted or threatened or called a suicide hotline in the past (before today)?	92 (27.2)	59.4	23.9
Q14. Do you lack religious beliefs?	76 (22.5)	19.4	23.6
Q15. Have you experienced rejection (in a relationship, in the family, at work) within the last three months?	93 (27.5)	37.5	26.7
Q16. Have you experienced chronic stress (i.e., lack of positive relationships, chronic hopelessness, social isolation)?	134 (39.6)	80.6	36.0
Q17. Do you have a history of impulsive behaviors related to anger, such as being in a rage, getting into physical fights, or seeking revenge?	103 (30.5)	45.2	29.3
Q18. Do you lack skills for coping with stress (i.e., have a habit of cracking under pressure)?	106 (31.4)	59.4	29.9
Q19. Do lack biological children or grandchildren?	78 (23.1)	40.6	21.2
Q20. Do you have history of command auditory hallucinations of self-directed violence (hearing voices telling you to harm yourself)?	44 (13.0)	31.3	11.1
Q21. Are you younger than 25 or older than 60?	103 (30.5)	25.0	31.0
Q22. Are you male?	164 (48.5)	59.4	47.4

CFI-S = Convergent Functional Information for Suicidality; SSEs = suicide spectrum events.

than it currently takes to complete our standard two question universal screening, is likely warranted given the potentially life-threatening consequences of a missed diagnosis.

Over half of patients who experienced suicide spectrum events in 180-day follow-up were not identified by standard screening. It is both striking and concerning that current screening methods missed more than half of patients who would go on to experience a suicide-related outcome. Given the weakness of current screening tools as well as of physician gestalt VAS, the

CFI-S has the ability to more effectively screen for high risk of suicidal outcomes and could help identify patients missed by current screening tools.

Possible future implications of this work include incorporation of more robust but still relatively time efficient risk stratification tools for all patients presenting to the ED and other high-risk care settings. In a universal screening protocol, patients with a CFI-S > 0.65 should be referred for urgent outpatient mental health evaluation and could be targeted in active community-based ED follow-up programs focused on

decreasing social isolation and supporting linkage to follow-up care. The 0.65 was determined as the cutoff of the CFI from the ROC curve that produced the highest diagnostic OR (likelihood ratio positive/likelihood ratio negative).

## LIMITATIONS

Our study sample was a convenience sample recruited from a single, urban safety net hospital, which may not represent a broad sample of patients in EDs across the United States. Our criterion standard relied on discovery from one or both of the following mechanisms: 1) patients had to be able to recall and volunteer to report suicidal events on telephone interview or 2) discovery of an accurate and clear description of a suicidal event documented by health care providers in medical records. It remains possible that these processes missed some suicidal events. Although all suicide spectrum events are important, those most dangerous (completed suicide) did not occur.

## CONCLUSION

In this single-center study that enrolled a heterogeneous sample of ED patients, current screening methods for suicidality failed to identify over half of those who went on to have a suicidal spectrum event in the next 180 days. Physician gestalt had moderate predictive accuracy. The CFIS has good accuracy for detection of those who would have future events, without directly questioning patients about suicidal thoughts. These data imply that the CFIS or some of its component items notably related to mental health and stress, may be useful to improve detection of suicidality risk in emergency care, leading to targeted and personalized preventive strategies. The CFIS was able to predict adverse suicide-related outcomes in some patients who screened negative for suicidal ideation at ED presentation and who were considered low risk by the physician evaluating them. We suggest that the broad implementation of CFIS in ED settings may be complementary to current approaches and improve the detection of patients at high risk for future suicidal events.

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## Supporting Information

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The following supporting information is available in the online version of this paper available at <http://onlinelibrary.wiley.com/doi/10.1111/acem.13562/full>

**Data S1.** Complete datasets and analyses (ABN 10-3-18 HLN6-26-2018).

**Table S1.** Predictions of SSE at 6 months.

**Table S2.** CFI-S predicting future SSE at 6 months follow-up in all patients.

**Table S3.** CFI-S predicting future SSE at 6 months follow-up in negative SCS patients