Validity of the Single-Item Screen–Cannabis (SIS-C) for Cannabis Use Disorder Screening in Routine Care

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Abstract

IMPORTANCE Cannabis use is prevalent and increasing, and frequent use intensifies the risk of cannabis use disorder (CUD). CUD is underrecognized in medical settings, but a validated single-item cannabis screen could increase recognition.

OBJECTIVE To evaluate the Single-Item Screen–Cannabis (SIS-C), administered and documented in routine primary care, compared with a confidential reference standard measure of CUD.

DESIGN, SETTING, AND PARTICIPANTS This diagnostic study included a sample of adult patients who completed routine cannabis screening between January 28 and September 12, 2019, and were randomly selected for a confidential survey about cannabis use. Random sampling was stratified by frequency of past-year use and race and ethnicity. The study was conducted at an integrated health system in Washington state, where adult cannabis use is legal. Data were analyzed from May 2021 to March 2022.

EXPOSURES The SIS-C asks about frequency of past-year cannabis use with responses (none, less than monthly, monthly, weekly, daily or almost daily) documented in patients’ medical records.

MAIN OUTCOMES AND MEASURES The Diagnostic and Statistical Manual, Fifth Edition (DSM-5) Composite International Diagnostic Interview–Substance Abuse Module (CIDI-SAM) for past-year CUD was completed on a confidential survey and considered the reference standard. The SIS-C was compared with 2 or more criteria on the CIDI-SAM, consistent with CUD. All analyses were weighted, accounting for survey design and nonresponse, to obtain estimates representative of the health system primary care population.

RESULTS Of 5000 sampled adult patients, 1688 responded to the cannabis survey (34% response rate). Patients were predominantly middle-aged (weighted mean [SD] age, 50.7 [18.1]), female or women (weighted proportion [SE], 55.9% [4.1]), non-Hispanic (weighted proportion [SE], 96.7% [1.0]), and White (weighted proportion [SE], 74.2% [3.7]). Approximately 6.6% of patients met criteria for past-year CUD. The SIS-C had an area under receiver operating characteristic curve of 0.89 (95% CI, 0.78-0.96) for identifying CUD. A threshold of less than monthly cannabis use balanced sensitivity (0.88) and specificity (0.83) for detecting CUD. In populations with a 6% prevalence of CUD, predictive values of a positive screen ranged from 17% to 34%, while predictive values of a negative screen ranged from 97% to 100%.

CONCLUSIONS AND RELEVANCE In this diagnostic study, the SIS-C had excellent performance characteristics in routine care as a screen for CUD. While high negative predictive values suggest that

(continued)
Abstract (continued)

the SIS-C accurately identifies patients without CUD, low positive predictive values indicate a need for further diagnostic assessment following positive results when screening for CUD in primary care.

Introduction

Nearly 50 million people in the United States use cannabis, reflecting a trend toward increasing use and decreasing perception of risk. Among primary care patients in Washington state, where adult cannabis use is legal, more than 20% report past-year cannabis use. Frequent cannabis use increases the risk of a cannabis use disorder (CUD), a pattern of continued cannabis use despite clinically significant impairment and distress. The prevalence of CUD ranges from 2% to 5% in the general population, 5% to 14% in young adults, and 8% to 23% among those with mental health or other substance use disorders. CUD is the largest contributor to cannabis-attributable disease burden, including injuries related to cannabis intoxication (eg, motor vehicle accidents), worsened mental health symptoms (eg, psychosis), other substance use disorders, other medical conditions (eg, bronchial system problems), and adverse pregnancy outcomes. Despite evidence-based treatment (ie, behaviorally based therapies), CUD remains underrecognized and largely untreated.

A brief, valid cannabis screen could increase identification of CUD, but it must be feasible for general medical settings with limited visit time. To our knowledge, no study has tested the validity of cannabis screens administered in routine care and documented in the electronic health record (EHR). Optimal screening tools for general medical settings typically include fewer than 4 items, with single items recommended. Single-item screens can be integrated with other behavioral health screens to increase the feasibility of routine CUD screening. Although validated single-item screens can identify substance use disorders generally, none are specific to CUD. Increasing cannabis use and legalization underscore the need to screen for cannabis separately from other substances. One health system integrated a question about the frequency of past-year cannabis use into routine care at the request of frontline clinicians. This study evaluated the performance of that Single-Item Screen–Cannabis (SIS-C) when documented in the EHR as part of routine care.

Methods

Setting

This prospective diagnostic study follows Standards for Reporting of Diagnostic Accuracy (STARD) reporting guideline and took place at Kaiser Permanente Washington (KPWA), an integrated health care system providing health insurance and medical care in Washington state, where adult cannabis use is legal. KPWA conducts annual population-based screening for behavioral health conditions (depression, alcohol, cannabis, and other drug use) in primary care using a 7-item questionnaire, with results documented in the EHR. A single item, the SIS-C (described in the Measures subsection), asks patients about the frequency of past-year cannabis use. Responses to the SIS-C trigger additional assessment for CUD, guiding clinical decision-making.

Sample

Adult patients (aged ≥18 years) at KPWA who completed the SIS-C in primary care between January 28 and September 12, 2019 (N = 108 950) were eligible to be sampled for a confidential cannabis survey (eFigure 1 in the Supplement). Patients were ineligible if they were current or recent KPWA employees (approximately 4%), needed an interpreter (2.6%), lived outside Washington state (<1%), were deceased (<1%), or opted out of research (<1%). Using EHR data, 5000 patients were randomly...
sampled for the survey. As detailed elsewhere, we oversampled for higher frequency of past-year cannabis use (58% daily, 24% weekly, 7% monthly, 6% less than monthly, 6% no use) and ensured 35% of the sample were individuals who belonged to minoritized racial and ethnic groups to obtain representation from important subgroups.

**Procedures**

Patients were recruited within 60 days of the SIS-C to ensure proximity of screen and survey responses. Patients were mailed invitations with information about the study, confidentiality, and unique identifiers linking responses to participants’ EHRs. Reminders were offered by telephone and email. The survey took approximately 20 minutes to complete online (63%) or by telephone (34%). Participants acknowledged informed consent online or by telephone prior to the survey and received $20 compensation.

The study sample included 1688 primary care patients who completed the survey, representing a 34% response rate, consistent with current health survey research. The KPWA Health Research Institute Institutional Review Board approved this study with waivers of consent (to identify eligible sample), consent documentation (for survey respondents), and HIPAA authorization.

**Measures**

**Reference Standard for Past-Year CUD**

The Composite International Diagnostic Interview Substance Abuse Module (CIDI-SAM) was selected as the reference standard for *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)* CUD based on demonstrated feasibility of administration. The 15-item CIDI-SAM provides a diagnosis and scaled score of CUD severity (0-11), reflecting the number of DSM-5 CUD criteria met. Any past-year CUD (mild to severe) was defined as 2 or more CUD criteria endorsed on the CIDI-SAM; moderate to severe past-year CUD was defined as 4 or more CUD criteria, consistent with the DSM-5. The first 2 survey questions asked about frequency and recency of cannabis use. Patients who reported no past-year use on both did not complete the CIDI-SAM to minimize assessment burden (n = 94). These patients were assigned a CIDI-SAM score of zero.

**EHR-Documented SIS-C**

The SIS-C, offered as part of routine primary care, asked about frequency of past-year cannabis use (“How often in the past year did you use marijuana?”) with response options (“never,” “less than monthly,” “monthly,” “weekly,” and “daily or almost daily”), adapted from the third question of the World Health Organization’s Alcohol Use Disorders Identification Test, and scored from 0 to 4 points. The term marijuana was not defined and could include medical and nonmedical use—relevant in cannabis-legal settings where medical authorization by a clinician is not required. The SIS-C was embedded in the 7-item behavioral health questionnaire, self-administered on paper during the study period. An electronic flag prompted administration of the screen after check-in if patients had not been screened in the past year, and a medical assistant entered responses into the EHR before the physician visit.

**Sociodemographic Characteristics and Comorbidities**

Demographic information collected from patients and documented in the EHR by the health system at the time of sampling was used to approximate the social conditions that shape the health of patients at different developmental stages and with different lived experiences (sexism, racism, other social determinants of health). This included age (18-29, 30-49, 50-64, or ≥65 years), sex or gender (female or woman or male or man; this administrative field may reflect biological sex or gender identity), race (American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Pacific Islander, White, other, or unknown), and ethnicity (Hispanic or non-Hispanic). Due to small sample sizes and/or low prevalence of CUD in certain subgroups, we combined age groups (18-29, 30-49, ≥50 years) and race and ethnicity (non-Hispanic Black,
non-Hispanic White, Hispanic) for subgroup analyses. Socioeconomic status was approximated using insurance status from enrollment records, marital status, education, employment, and type of residence reported on survey. Mental health and substance use disorder diagnoses were based on International Classification of Disease, Tenth Revision codes documented in the EHR or insurance claims in the year prior to survey completion.

**Statistical Analysis**

**Survey Weighting**

All analyses were weighted to account for stratified random sampling and nonresponse. Specifically, we calculated sampling weights by taking the inverse probability of being sampled within 10 sampling strata resulting from the 5 cannabis screen responses and indicator for patients who belong to minoritized racial and ethnic groups. We calculated nonresponse weights using logistic regression to estimate inverse probabilities of survey nonresponse based on sociodemographic characteristics. We multiplied sampling weights and nonresponse weights to obtain estimates representative of the KPWA primary care population. Comparisons of the eligible primary care population, eligible survey sample, nonrespondents, respondents, and the weighted primary care sample have been previously reported.

**Descriptive and Screening Test Performance Characteristics**

We described characteristics of the sample, including the frequency of each response option on the SIS-C. We compared the SIS-C with the reference standard of any CUD and moderate to severe CUD. To assess screening test performance characteristics, we estimated sensitivity (true-positive rate) and specificity (true-negative rate) for each cut point on the SIS-C. We depicted receiver operating characteristic (ROC) curves graphically and estimated area under the curves (AUCs). ROC curves provide a useful summary of the overall discriminatory power of a screening test. AUCs can range from 0 to 1.0, with 0.8 to 0.9 considered excellent performance and greater than 0.9 considered outstanding. We estimated 95% CIs for weighted AUC estimates using nonparametric bootstrapping with 10,000 replications.

**Differences Across Sociodemographic Subgroups**

To determine whether the SIS-C performs differently across sociodemographic subgroups, we plotted ROC curves stratified by age, sex or gender, and race and ethnicity. We evaluated differences between AUCs across subgroups and bootstrapped 95% CIs for differences; 95% CIs that did not contain zero indicated statistically significant between-group differences.

**Predictive Value of SIS-C for CUD**

Although positive and negative predictive values (indicating the probability of a condition given a positive screening result and absence of a condition with a negative screening result) are often reported in validation studies, these postscreening probabilities are highly dependent on the prevalence of the condition in the screened population. Using Bayes theorem, we modeled the probability a patient has CUD if the SIS-C is positive and the probability a patient does not have CUD if the SIS-C is negative across a range of prevalence estimates for CUD (<0.5% to 30%) to understand performance when applied to different populations. Analyses used Stata version 15.1 (StataCorp), R version 4.0.2 (R Project for Statistical Computing), and Excel version 2202 (Microsoft Corp) and were conducted from May 2021 to March 2022.

**Results**

Table 1 describes the sample, which was weighted to reflect the eligible primary care population screened for cannabis use. The weighted sample was predominantly middle-aged (weighted mean [SD] age, 50.7 [18.1]), female or women (weighted proportion [SE], 55.9% [4.1]), non-Hispanic...
(weighted proportion [SE], 96.7% [1.0]), White (weighted proportion [SE], 74.2% [3.7]), married or living with a partner (weighted proportion [SE], 62.8% [4.0]), with indicators of higher socioeconomic status. More than 25% had mental health diagnoses, and 5% had substance use disorder diagnoses. Based on the survey-administered CIDI-SAM reference standard, 6.6% of

<table>
<thead>
<tr>
<th>Table 1. Characteristics of the Eligible Primary Care Population</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient characteristics</strong></td>
</tr>
<tr>
<td>Age**</td>
</tr>
<tr>
<td>18-29</td>
</tr>
<tr>
<td>30-49</td>
</tr>
<tr>
<td>50-64</td>
</tr>
<tr>
<td>≥65</td>
</tr>
<tr>
<td>Sex or gender*</td>
</tr>
<tr>
<td>Female or women</td>
</tr>
<tr>
<td>Male or men</td>
</tr>
<tr>
<td>Race*</td>
</tr>
<tr>
<td>American Indian or Alaska Native</td>
</tr>
<tr>
<td>Asian</td>
</tr>
<tr>
<td>Black or African American</td>
</tr>
<tr>
<td>Native Hawaiian or Pacific Islander</td>
</tr>
<tr>
<td>White</td>
</tr>
<tr>
<td>Other or unknown raceb</td>
</tr>
<tr>
<td>Hispanic ethnicitya</td>
</tr>
<tr>
<td>Insurancea</td>
</tr>
<tr>
<td>Medicaid or subsidized</td>
</tr>
<tr>
<td>Medicare</td>
</tr>
<tr>
<td>Commercial</td>
</tr>
<tr>
<td>Unknown</td>
</tr>
<tr>
<td>Marital statusc</td>
</tr>
<tr>
<td>Married or living with partner</td>
</tr>
<tr>
<td>Widowed</td>
</tr>
<tr>
<td>Divorced or separated</td>
</tr>
<tr>
<td>Single or never married</td>
</tr>
<tr>
<td>Missing</td>
</tr>
<tr>
<td>Educationc</td>
</tr>
<tr>
<td>≤High school</td>
</tr>
<tr>
<td>Some college</td>
</tr>
<tr>
<td>≥4 Years of college</td>
</tr>
<tr>
<td>Missing</td>
</tr>
<tr>
<td>Employmentc</td>
</tr>
<tr>
<td>Employed full time</td>
</tr>
<tr>
<td>Employed part time</td>
</tr>
<tr>
<td>Retired</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Unemployed</td>
</tr>
<tr>
<td>Missing</td>
</tr>
<tr>
<td>EHR-documented past-year diagnosesa</td>
</tr>
<tr>
<td>Mental health diagnosis</td>
</tr>
<tr>
<td>SUD diagnosis</td>
</tr>
<tr>
<td>Mental health or SUD diagnosis</td>
</tr>
<tr>
<td>CIDI-SAM criteria for cannabis use disorderc,d</td>
</tr>
<tr>
<td>&lt;2, No CUD</td>
</tr>
<tr>
<td>2-3, Mild CUD</td>
</tr>
<tr>
<td>≥4, Moderate to severe CUD</td>
</tr>
</tbody>
</table>

Abbreviations: CIDI-SAM, Composite International Diagnostic Interview Substance Abuse Module; CUD, cannabis use disorder; EHR, electronic health record; SUD, substance use disorder.

* Data collected from EHRs.

b Patients are provided the option to indicate other when choosing among 1 or more race categories at appointing or check-in.

c Data collected from confidential survey.

d Participants who reported no past-year cannabis use on the survey were assigned a score of 0 on the CIDI-SAM.
primary care patients met criteria for any past-year DSM-5 CUD and 1.9% for moderate to severe CUD. Characteristics stratified by CUD are available in eTable 1 in the Supplement.

**Identification of Any Past-Year CUD**

The SIS-C had excellent performance characteristics as a screen for any past-year CUD (Table 2), with an AUC of 0.89 (95% CI, 0.78-0.96) (Figure). Report of any cannabis use (ie, less than monthly or more frequent use) on the SIS-C balanced sensitivity (88%) and specificity (83%).

The probability of any past-year CUD based on a positive SIS-C (positive predictive value) varied across the range of population-based prevalences and screening thresholds (Table 3). If the underlying prevalence of CUD were 4% in the screened population, the probability of CUD in patients with positive SIS-C screens ranged from 12% to 26% across screening thresholds (less than monthly to daily or almost daily). The probability of no CUD in patients with negative SIS-C screens (negative predictive value) ranged from 98% to 100%. If the population prevalence of CUD were 8% (eg, prevalence among young men), the probability of CUD in patients with positive SIS-C screens ranged from 22% to 42%, and the probability of no CUD for patients with negative SIS-C screens ranged 95% to 100%. If the prevalence of CUD were 20% to 30% (eg, prevalence among patients with mental health or substance use disorders), the probability of CUD in patients with positive SIS-C screens ranged from 45% to 78%, and the probability of no CUD in patients with negative SIS-C screens ranged from 81% to 100%.

**Table 2. Prevalence and Performance Characteristics of the Single-Item Screen–Cannabis for Identification of Past-Year Cannabis Use Disorder**

<table>
<thead>
<tr>
<th>Potential cut points for the Single-Item Screen–Cannabis</th>
<th>Prevalence of response</th>
<th>Screening performance for past-year CUD</th>
<th>Moderate–Severe CUD&lt;sup&gt;c&lt;/sup&gt;</th>
<th>Sensitivity, %</th>
<th>Specificity, %</th>
<th>AUC (95% CI)&lt;sup&gt;d&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>Unweighted, No.</td>
<td>Weighted, % (SE)</td>
<td>Unweighted, No.</td>
<td>Sensitivity, %</td>
<td>Specificity, %</td>
<td>AUC (95% CI)&lt;sup&gt;d&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>99</td>
<td>78.1 (2.0)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>0.89 (0.78-0.96)</td>
</tr>
<tr>
<td>≥ Less than monthly</td>
<td>99</td>
<td>9.6 (1.2)</td>
<td>88</td>
<td>83</td>
<td>100</td>
<td>0.95 (0.94-0.96)</td>
</tr>
<tr>
<td>≥ Monthly</td>
<td>118</td>
<td>3.3 (0.4)</td>
<td>71</td>
<td>92</td>
<td>96</td>
<td>0.96 (0.89-0.99)</td>
</tr>
<tr>
<td>≥ Weekly</td>
<td>376</td>
<td>4.0 (0.4)</td>
<td>57</td>
<td>94</td>
<td>81</td>
<td>0.92 (0.85-0.97)</td>
</tr>
<tr>
<td>Daily or almost daily</td>
<td>996</td>
<td>5.1 (0.4)</td>
<td>36</td>
<td>97</td>
<td>57</td>
<td>0.96 (0.89-0.99)</td>
</tr>
</tbody>
</table>

Abbreviations: AUC, area under the receiver operating characteristic curve; CUD, cannabis use disorder; NA, not applicable.

<sup>a</sup> Endorsed 2 or more criteria on the Composite International Diagnostic Interview–Substance Abuse Module.

<sup>b</sup> Endorsed 4 or more criteria on the Composite International Diagnostic Interview–Substance Abuse Module.

<sup>c</sup> The Single-Item Screen–Cannabis asked, “How often in the past year did you use marijuana?” with responses documented in the electronic health record as part of routine care.

<sup>d</sup> The 95% CIs were obtained using nonparametric bootstrapping of weighted AUC estimates.

**Figure. Receiver Operating Characteristic Curves for the Single-Item Screen–Cannabis Compared With the Reference Standard for Past-Year Cannabis Use Disorder**

The Single-Item Screen–Cannabis is administered annually to primary care patients and asks about the frequency of past-year cannabis use (never, less than monthly, monthly, weekly, daily or almost daily). The Composite International Diagnostic Interview–Substance Abuse Module was used as the reference standard for past-year Diagnostic and Statistical Manual, Fifth Edition cannabis use disorder and was administered to survey participants on a confidential survey. The Single-Item Screen–Cannabis was compared with any cannabis use disorder (Composite International Diagnostic Interview–Substance Abuse Module ≥2) and moderate-severe cannabis use disorder (Composite International Diagnostic Interview–Substance Abuse Module ≥4).
Identification of Moderate to Severe CUD
The SIS-C had outstanding performance characteristics for past-year moderate to severe CUD, with an AUC of 0.95 (95% CI, 0.94-0.96) (Figure). Report of monthly or more frequent cannabis use balanced sensitivity (96%) and specificity (89%). Report of daily or almost daily cannabis use had high specificity (96%) but lower sensitivity (57%) (Table 2).

The probability of past-year moderate to severe CUD based on a positive or negative SIS-C screen varied across the range of population-based prevalences and screening thresholds (Table 3). Probabilities were slightly higher than those reported for any CUD.

Performance Across Sociodemographic Subgroups
There were statistically significant but small differences in the performance of the SIS-C across age and race and ethnicity. Full results appear in the eAppendix, eFigure 2, and eTable 2 in the Supplement.

Discussion
This study evaluated the screening performance of the SIS-C, a single-item cannabis screen administered and documented in the EHR as part of routine primary care in a US state where adult cannabis use is legal. Among primary care patients, 6.6% met criteria for past-year DSM-5 CUD based on the confidential CIDI-SAM reference standard, slightly higher than national survey estimates. The SIS-C had excellent performance characteristics as a screening test for any past-year CUD and outstanding performance characteristics for moderate to severe CUD. Report of any past-year CUD

Table 3. Probability of Past-Year CUD if SIS-C Is Positive (or Negative) Across a Range of Population-Based Prevalence Estimates for CUD

<table>
<thead>
<tr>
<th>Threshold for positive SIS-C</th>
<th>Population prevalencea</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5%</td>
</tr>
<tr>
<td>Any CUD</td>
<td></td>
</tr>
<tr>
<td>Probability patient has CUD if SIS-C is positive, %</td>
<td></td>
</tr>
<tr>
<td>≥Less than monthly</td>
<td>1.6</td>
</tr>
<tr>
<td>≥Monthly</td>
<td>2.6</td>
</tr>
<tr>
<td>≥Weekly</td>
<td>2.8</td>
</tr>
<tr>
<td>Daily or almost daily</td>
<td>4.0</td>
</tr>
<tr>
<td>Probability patient does not have CUD if SIS-C is negative, %</td>
<td></td>
</tr>
<tr>
<td>≥Less than monthly</td>
<td>100.0</td>
</tr>
<tr>
<td>≥Monthly</td>
<td>99.9</td>
</tr>
<tr>
<td>≥Weekly</td>
<td>99.8</td>
</tr>
<tr>
<td>Daily or almost daily</td>
<td>99.7</td>
</tr>
<tr>
<td>Moderate to severe CUD</td>
<td></td>
</tr>
<tr>
<td>Probability patient has CUD if SIS-C is positive, %</td>
<td></td>
</tr>
<tr>
<td>≥Less than monthly</td>
<td>1.5</td>
</tr>
<tr>
<td>≥Monthly</td>
<td>2.4</td>
</tr>
<tr>
<td>≥Weekly</td>
<td>3.0</td>
</tr>
<tr>
<td>Daily or almost daily</td>
<td>4.5</td>
</tr>
<tr>
<td>Probability patient does not have CUD if SIS-C is negative, %</td>
<td></td>
</tr>
<tr>
<td>≥Less than monthly</td>
<td>100.0</td>
</tr>
<tr>
<td>≥Monthly</td>
<td>100.0</td>
</tr>
<tr>
<td>≥Weekly</td>
<td>99.9</td>
</tr>
<tr>
<td>Daily or almost daily</td>
<td>99.8</td>
</tr>
</tbody>
</table>

Abbreviations: CUD, cannabis use disorder; SIS-C, Single-Item Screen–Cannabis.

a Range of prevalence estimates for past-year Diagnostic and Statistical Manual for Mental Disorders, Fifth Edition. CUD was based on prior literature finding the overall prevalence of any CUD to be 2% to 4% and the overall prevalence of moderate to severe CUD to be 1% to 2%, with higher prevalence estimates for some subgroups (eg, men, young adults, patients with mental health and substance use disorder) and lower prevalence estimates for some subgroups (eg, women, older adults).
cannabis use balanced sensitivity and specificity for any CUD, whereas report of monthly or more frequent cannabis use balanced sensitivity and specificity for moderate to severe CUD.

While there are several substance use screens validated in general adult patient populations,23,28-31,39,63-67 few are single-item.28-31 no single-item screens are specific to cannabis use, and none have been validated when administered during routine care and documented in the medical record (Table 4). Existing single-item screens28-31 combine cannabis screening with other illegal drugs. In the context of legalization and increasing prevalence, clinicians may want to screen for cannabis separately from other drugs, as is recommended for alcohol.27 One previously validated brief screen includes cannabis-specific items, but only in the second stage of a 2-stage screening process.39 Other previously validated cannabis-specific screens (Cannabis Abuse Problems Identification Test [CUPIT], Cannabis Use Disorder Identification Test [CUDIT], CUDIT-Revised) provide more detail but may not be practical for use in routine care due to their length (>4 items) or appropriate due to validation only in people who use cannabis (CUDIT-Short Form, Severity of Dependence Scale).71,72

This is the first study, to our knowledge, to evaluate the performance characteristics of any substance use screen when used in routine clinical care. Patients may respond differently to substance use screens when administered in clinical settings—where clinicians will see results in the medical record—compared with when administered in confidential research settings. It is promising, therefore, that the performance of the EHR-documented SIS-C for any CUD was comparable with the performance of single-item drug screens validated in research settings,28-31 and its performance for identifying moderate to severe CUD was stronger.28 Approximately 90% of KPWA primary care patients are screened annually with the SIS-C, demonstrating routine use is feasible and clinically useful.

The SIS-C performed well across all groups based on age, sex or gender, and race and ethnicity, but performance characteristics were less strong for younger and middle-aged adults relative to older adults. Because young adults have a higher prevalence of CUD and may be more susceptible to risks of CUD,73 the lowest threshold on the SIS-C (any use) may be preferred. Performance characteristics were also less strong for Hispanic patients relative to non-Hispanic White patients. Hispanic patients may underreport cannabis use to avoid repercussions stemming from intersecting cannabis and anti-immigration stigma.48

Selection of a SIS-C screening threshold for detecting CUD will depend on the prevalence of CUD in the setting where screening is taking place and resources for follow-up assessment and care. Although any use and monthly use were the optimal screening thresholds for identifying any CUD and moderate to severe CUD, respectively, applying Bayes theorem, we found that the probability a patient with a positive screen has CUD was low when the underlying prevalence of CUD in the screened population was less than 8%. A lower threshold, such as any use, may be appropriate for some settings (eg, mental health) and populations (eg, young men) expected to have a higher prevalence of CUD9-12; whereas a higher threshold, such as daily use, may be appropriate for general medical settings.8-10 Threshold selection also depends on how a positive screen will be used, the costs of false-positive results, and the benefits of true-positive results.75,76 Costs of screening include time and resources to administer further assessment and inappropriate diagnostic labeling of patients.34 Benefits of screening include identifying at-risk patients for prevention and harm reduction, clinician recognition of underlying reasons for cannabis use (eg, chronic pain, insomnia, depression, anxiety)35,77 and treatment options.19 Prioritizing a sensitive threshold may be appropriate as part of behavioral health screening in primary care settings when the screen is followed by low-cost, low-burden, nonstigmatizing symptom assessment and discussion of symptoms.27,41 Prioritizing a specific threshold that minimizes false positive screens might be more appropriate in resource-constrained settings or those in which a positive screen results in referral.57

The SIS-C is not a replacement for assessment of CUD symptoms or for making a diagnosis. Many—or most—patients who screen positive on the SIS-C will not meet criteria for CUD, as reflected by low positive predictive values. This is common when the underlying prevalence of the screened...
<table>
<thead>
<tr>
<th>Screen</th>
<th>Items, No.</th>
<th>Validated for CUD</th>
<th>Validated for SUD</th>
<th>Administration</th>
<th>Research or interview</th>
<th>Sensitivity, %</th>
<th>Specificity, %</th>
<th>AUC</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIS-C</td>
<td>1</td>
<td>No</td>
<td>Yes (CIDI-SAM)</td>
<td>Self</td>
<td>Routine care</td>
<td>88</td>
<td>93</td>
<td>0.89</td>
</tr>
<tr>
<td>SoDU</td>
<td>2 (1 to ascertain cannabis use)</td>
<td>No</td>
<td>Yes (MINI)</td>
<td>Yes (MINI)</td>
<td>Interview</td>
<td>SUD and CUD: item 1, ≥7 or item 2, ≥2 (0-365 d)</td>
<td>92</td>
<td>88</td>
</tr>
<tr>
<td>TAPS</td>
<td>39</td>
<td>4-30</td>
<td>Yes</td>
<td>No</td>
<td>Yes (CIDI-SAM) interview</td>
<td>71</td>
<td>95</td>
<td>NA</td>
</tr>
<tr>
<td>TAPS-1</td>
<td>28</td>
<td>4 (1 item for illegal drugs)</td>
<td>No</td>
<td>No</td>
<td>Yes (CIDI-SAM and IDT)</td>
<td>85</td>
<td>83</td>
<td>0.89</td>
</tr>
<tr>
<td>ASSIST-Drug</td>
<td>65</td>
<td>1-2</td>
<td>Yes</td>
<td>0</td>
<td>No</td>
<td>Yes (MINI)</td>
<td>95</td>
<td>88</td>
</tr>
<tr>
<td>DAST-24</td>
<td>2</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes (CIDI-SAM) interview</td>
<td>94</td>
<td>89</td>
<td>0.92</td>
</tr>
<tr>
<td>RDPS</td>
<td>23,63</td>
<td>1-2 (+1 to ascertain cannabis use)</td>
<td>Yes</td>
<td>0</td>
<td>No</td>
<td>Yes (CIDI-SAM) interview</td>
<td>95</td>
<td>88</td>
</tr>
<tr>
<td>TICS</td>
<td>2</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes (CIDI-SAM) interview</td>
<td>95</td>
<td>88</td>
<td>0.92</td>
</tr>
</tbody>
</table>

Abbreviations: ASSIST-Drug, Alcohol, Smoking and Substance Involvement Screening Test–Drug; AUC, area under the curve; CIDI-SAM, Composite International Diagnostic Interview–Substance Abuse Module; CUD, cannabis use disorder; DAST-2, Drug Abuse Screening Test; DUD, drug use disorder; IDT, interview, and Other Substance Use; TICS, Two-Item Conjoint Screen; WMH-CIDI, World Mental Health Composite International Diagnostic Interview.
condition is low. Follow-up administration of longer assessments using DSM-5 criteria will be important for diagnosis of CUD. Furthermore, the SIS-C provides a starting point for asking patients about cannabis use to support clinicians in exploring reasons for use—including medical reasons—and discussing benefits and risks of use. Finally, high negative predictive values suggest that the SIS-C accurately identifies patients without CUD so that patients who screen negative need no further evaluation.

Limitations
This study has limitations. While the CIDI-SAM is considered a criterion-standard measure of CUD, in-person administration and urine drug screening were not feasible. We used the entire survey sample, assuming no CUD criteria for respondents who indicated no past-year use on 2 different questions, to increase representation across the spectrum of cannabis use and minimize spectrum bias. This approach could introduce measurement error, but we expected minimal bias, as participants indicated no past-year cannabis use twice. The CIDI-SAM asked about “cannabis” use, whereas the SIS-C asked about “marijuana”; it is unclear whether patients interpreted these terms synonymously or whether they considered medical use and/or other cannabis products in their response on the SIS-C. Only 34% of invited patients completed the survey. Although lower than desired, this response rate is consistent with industry averages and reflects a national trend of declining response rates. Consequently, responses from a small number of patients may have contributed disproportionately to analyses due to weighting for oversampling design and nonresponse. These weights were estimated using measured factors and cannot account for unmeasured factors; however, we found patient characteristics of the weighted sample were similar to the eligible primary care population and other KPWA patients overall. We were unable to conduct subgroup analyses for all age and race subgroups due to small sample sizes. Additionally, this study was conducted in a state with legal cannabis use and among patients who were largely White, commercially insured, and with high socioeconomic status, potentially limiting generalizability. Future studies are needed to evaluate the SIS-C in settings where adults may experience legal consequences for cannabis use.

Conclusions
This study found that the SIS-C—a self-administered, single-item screen for CUD—had excellent performance characteristics when used in routine primary care in a setting with legal cannabis use. The screening thresholds can be tailored to patient populations and the needs and preferences of health settings. The SIS-C can be easily integrated with other behavioral health screening, making screening for CUD feasible in primary care.
Author Contributions: Dr Matson had full access to all of the data in the study and takes responsibility for the
integrity of the data and the accuracy of the data analysis.

Concept and design: Matson, Lapham, Bobb, Williams, Bradley.

Acquisition, analysis, or interpretation of data: All authors.

Drafting of the manuscript: Matson, Williams.

Critical revision of the manuscript for important intellectual content: All authors.

Statistical analysis: Matson, Lapham, Bobb.

Obtained funding: Lapham, Bradley.

Administrative, technical, or material support: Oliver, Bradley.

Supervision: Lapham, Hallgren, Williams, Bradley.

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preparation of the manuscript; or decision to submit the manuscript for publication.

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Meeting Presentation: Results of this study were presented at the NIDA CTN Steering Committee Meeting; April
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Scotland.

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study. We would also like to acknowledge the contributions of Kaiser Permanente Washington clinicians who
helped develop and implement the Single-Item Screen–Cannabis into routine care. Finally, we would like to express
our appreciation for this study's project manager (Casey Luce, MSPH) as well as members of the survey research
program at Kaiser Permanente Washington Health Research Institute, who managed survey recruitment and
administration.

Additional Information: Statistical code is available from Dr Matson. In keeping with National Institutes of Health
values, in which the rights and privacy of individuals must be protected at all times, data set disclosures to other
entities would require (1) a data transfer agreement between Kaiser Permanente Washington and said entities, (2)
deidentification of the data set, and (3) appropriate institutional review board approvals. Investigators wishing to
obtain these data should contact the corresponding author to discuss the request. Requests may require funding for
programming to create a deidentified analytic data set(s) and to establish the appropriate data transfer
agreement(s) and institutional review board approval(s).

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1383-1391. doi:10.1016/S0140-6736(09)61037-0


**SUPPLEMENT.**

*eFigure 1.* Flow Diagram of Study Sample

*eTable 1.* Characteristics of the Eligible Primary Care Population (N=1688), Stratified by Severity of Past-Year Cannabis Use Disorder (CUD)

*eAppendix.* Performance of the SIS-C Across Sociodemographic Subgroups

*eFigure 2.* Receiver Operating Characteristic (ROC) Curves for the Single-Item Screen-Cannabis (SIS-C) Compared With the Reference Standard for Past-Year Cannabis Use Disorder (CUD), Stratified by Subgroups

*eTable 2.* Differences in Area Under the Receiver Operating Characteristic Curve (AUC) Estimates Comparing Performance of the SIS-C Between Demographic Subgroups and Performance SIS-C With Other Survey Measures