

Accuracy of HIV Risk Perceptions Among Episodic Substance-Using Men Who Have Sex with Men

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Abstract Using the HIV Incident Risk Index for men who have sex with men—an objective and validated measure of risk for HIV acquisition, and self-perceptions of belief and worry about acquiring HIV, we identified individuals who underestimated substantial risk for HIV. Data from a racially/ethnically diverse cohort of 324 HIV-negative episodic substance-using men who have sex with men (SUMSM) enrolled in a behavioral risk reduction intervention (2010–2012) were analyzed. Two hundred and fourteen (66%) SUMSM at substantial risk for HIV were identified, of whom 147 (69%, or 45% of the total sample) underestimated their risk. In multivariable regression analyses, compared to others in the cohort, SUMSM who underestimated their substantial risk were more likely to report: a recent sexually transmitted infection diagnosis, experiencing greater social isolation, and exchanging sex for drugs, money, or other goods. An objective risk screener can be valuable to providers in identifying and discussing with SUMSM factors associated with substantial HIV risk, particularly those who may not recognize their risk.

Resumen Este estudio utilizó el índice de riesgo de incidentes de VIH para hombres que tienen sexo con hombres (HIRI-HSH)—una medida objetiva y validada de riesgo para la adquisición del VIH—y autopercepción de creencia y preocupación de contraer el VIH para identificar individuos que subestimaron su riesgo substancial para el VIH. Se analizaron los datos de un cohorte de diversidad racial/étnica de 324 HSH, VIH-negativos usuarios de sustancias de forma episódica (por sus siglas en inglés, SUMSM) inscritos en una intervención de reducción de riesgo del comportamiento (2010–2012). Dos ciento catorce (66%) se identificaron SUMSM con substancial riesgo de VIH, de los cuales 147 (69% o 45% de la muestra total) subestima el riesgo. En el análisis multivariado de regresión, en comparación con el resto del cohorte, los SUMSM más propensos fueron los que subestimaron su riesgo sustancial: una reciente transmisión diagnóstico de infección, experimentando mayor aislamiento social y el intercambio de sexo por drogas, dinero ni otras cosas. La medida objetiva de riesgo para la adquisición de VIH, puede ser una herramienta valiosa para ayudar a los proveedores identificar e iniciar conversaciones con SUMSM sobre los factores importantes asociados con riesgo de VIH, particularmente para aquellos que no pueden reconocer conductas de riesgo.

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Introduction

For gay, bisexual, and other men who have sex with men (MSM)—the population most severely affected by HIV—annual number of new HIV diagnoses in the United States has risen 6%, despite declines for other populations

[1, 2]. Smith et al. [3] developed a seven-item clinical screening index to help clinicians and other prevention providers identify MSM at substantial risk for HIV. The HIV Incident Risk Index for MSM (HIRI-MSM), a validated screening tool for predicting incident HIV infections among uninfected MSM, generates a score based on patient's age and several self-reported HIV-related risk behaviors including: number of male partners, number of HIV-positive male partners, number of condomless receptive anal intercourse (CRAI) events, number of condomless insertive anal intercourse (CIAI) events with HIV-positive partners, and the use of methamphetamines or amyl nitrite (poppers). In a validation sample, the HIRI-MSM had a high sensitivity rate in that it accurately predicted 84% of HIV-negative MSM enrolled in two large clinical trials who later tested positive at their next clinical visit [3].

Primary care physicians do not always discuss sexual behaviors with their male patients [3], thus requiring patients interested in HIV prevention to initiate the conversation. While some MSM who think they are at risk for HIV may raise their concerns with their health care providers, others do not perceive themselves to be at risk and may be particularly fearful of judgmental, stigmatized relations with care providers, and may not consult a health care provider for intervention or risk-reduction strategies [4]. Individual perceptions of HIV risk can vary in accuracy and result in missed opportunities for prevention including antiretroviral pre-exposure prophylaxis (PrEP), behavioral prevention interventions, HIV diagnosis or antiretroviral treatment [5]. Self-perceptions of risk undergird several behavior change theories [6–9] and may be linked to engaging in safer sexual behaviors and other positive health outcomes. As HIV has evolved into a manageable chronic illness, decreased concerns about acquiring HIV may lead some individuals to become less aware, complacent about prevention efforts, or negligent in seeking care.

In this study, we sought to determine whether or not self-perceptions of risk were congruent with more objective estimates of behavioral risk based on the HIRI-MSM in a sample of episodic substance-using MSM (SUMSM) enrolled in an HIV risk-reduction behavioral intervention clinical trial [10]. We identified men in the trial who underestimated their substantial risk for acquiring HIV and compared their demographic, psychosocial and behavioral characteristics to other at-risk SUMSM enrolled in the intervention. In doing so, we sought to identify characteristics of SUMSM who may be at greatest need for HIV prevention messaging and risk-reduction interventions.

Methods

Procedures

From May 2010 to May 2012, SUMSM who reported condomless anal intercourse while under the influence of alcohol and/or drugs were enrolled in a study testing the efficacy of an HIV risk-reduction intervention [10]. SUMSM were recruited through San Francisco-based community locations such as bars, clubs, grocery stores, gyms and ethnically and racially diverse community-based organizations popular among MSM populations [10]. After receiving more detailed information about the study, potential participants were assessed initially over the phone and then again in person to determine their eligibility [10]. At baseline, eligible participants completed an audio computer assisted self-interview (ACASI) and were later randomized into either the Personal Cognitive Counseling (PCC) intervention session or given a rapid HIV test with a description of the testing procedures [10]. Additional details regarding the original study recruitment and methods are reported elsewhere [10]. The current secondary analysis includes baseline data only.

In the original study, the PCC intervention was adapted for MSM who were episodic substance users. Episodic substance users were selected because it was believed they would be able to cognitively engage and act upon the material delivered in this brief intervention, whereas, those who used substances more frequently would likely require more intensive interventions to effect behavioral change. Informed by epidemiologic data current at the time of protocol development, episodic substance use was defined as recreational or less than weekly use of alcohol and other drugs. This criteria was supported by longitudinal within-participant analyses demonstrating an association between less than weekly use of these substances and greatly elevated sexual risk [11]. Eligible participants: (a) were 18 years of age or older; (b) self-identified as male; (c) reported condomless anal intercourse with a man while under the influence of at least one or any combination of substances (methamphetamines, poppers, powder/crack cocaine, or drinking five or more alcoholic drinks [binge drinking]) within 2 h before or during sex within the past 6 months; (d) had not injected any substances in the past 6 months; (e) were not currently receiving substance-use treatment or involved in a self-help program or receiving HIV treatment or enrolled in an HIV prevention study; (f) reported an HIV-negative or unknown serostatus; (g) were willing and able to participate in a sexual risk behavior and substance-use risk-reduction intervention; (h) did not plan to move from the San Francisco Bay Area during the study period; and (i) were able to read, speak and understand English. Men deemed ineligible due to frequency of substance-use were offered community referrals for substance-use treatment. All participants

provided written informed consent. Of the 2,649 men originally screened, 431 (16.3%) met the stringent eligibility criteria and 326 (75.6%) agreed to participate. Participants of the original study were compensated \$35 for completing the baseline assessment and the University of California San Francisco (UCSF) approved the original study protocol IRB #: UCSF CHR 10-03925.

Measures

Data were collected via the baseline ACASI. Survey items in four categories were used for analysis: (1) sociodemographic characteristics, (2) psychosocial characteristics, (3) HIV-related risk behaviors, and (4) self-perception of HIV risk.

Sociodemographic Characteristics

Sociodemographic characteristics included race, age, education, and several indicators of income status (being underemployed, having an income below poverty level for San Francisco, having health insurance; ever being homeless), having a regular health care provider, and ever being incarcerated. Race was a single item in the ACASI which also included Hispanic/Latino as an option. Age was categorized into four age bands consistent with the HIRI-MSM screener: 18–28, 29–40, 41–48, and 49 years or older. Education was dichotomized into greater than a high school degree vs. high school degree or less. Employment was dichotomized into less than full employment and/or student status with any type of employment versus those with full-time employment.

Psychosocial Characteristics

Psychosocial characteristics included depressive symptoms, social isolation, and experience of racial discrimination. Depression symptoms were assessed using the CES-D scale, and those with a score of 16 or higher were classified as depressed based on having clinical levels of depression symptoms [12]. Internal consistency in the current sample was excellent (Cronbach's $\alpha = 0.92$).

Social isolation was measured with a modified version of a 15-item scale measuring self-determination and social isolation [13]. Specifically, the following four items that assessed frequency of experiencing social isolation were selected: *How often do you feel you lack companionship?*, *How often do you feel there is no one you can turn to?*, *How often do you feel alone?*, and *How often do you feel left out?* Each item was scored on a 4-point response scale (never, sometimes, most of the time, always). Internal consistency for the modified scale was good (Cronbach's $\alpha = 0.84$). Based on a median split, participants who had a combined score of 4 or higher were categorized as experiencing more social isolation.

Four items assessed frequency of experiencing racial discrimination during adulthood [14]: *As an adult, how often have you been hit or beaten up because of your race or ethnicity?*, *As an adult, how often have you been treated rudely or unfairly because of your race or ethnicity?*, *As an adult, how often have you been harassed by police because of your race or ethnicity?*, and *How often have you been made to feel uncomfortable in a white gay bar or club because of your race or ethnicity?* Each item was scored on a 4-point response scale (never, once or twice, a few times, many times). Internal consistency (Cronbach's $\alpha = 0.66$) was near the acceptable level; the measure was retained for its exploratory benefit. Based on a median split, participants who had a composite score of 11 or higher were classified as experiencing more racial discrimination as an adult.

HIV-Related Risk and Health Behaviors

Respondents were asked to report the total number of male sexual partners, the number of known HIV-positive male sexual partners, the number of unprotected (condomless) receptive anal intercourse events (CRAI) with any HIV status partner, and the number of condomless insertive anal intercourse events with any HIV-positive partners (CIAI) they had in the past 90 days. Respondents were also asked about the types and number of substances used, including methamphetamines and amyl nitrate (poppers). These behaviors mirrored those included in the HIRI-MSM screener, and answers were categorized and scored in accordance with Smith et al. [3].

In addition, exchanging sex, which has been associated with elevated risks for HIV acquisition [15] and being HIV-positive unaware [16], was assessed using two items: *In the past 90 days, approximately how many times did you receive [or: give (second question)] money, drugs, or material goods in exchange for anal sex?* If a participant reported one or more times for either item, they were classified as someone who exchanged sex for money, drugs, or goods in the past 90 days.

Men were asked to complete the Severity of Substance Dependency (SDS) scale, a validated measure designed to evaluate psychological dependence on different substances [17]. Five questions for each of the following items were assessed: methamphetamines (Cronbach's $\alpha = 0.80$), poppers (Cronbach's $\alpha = 0.73$), cocaine (Cronbach's $\alpha = 0.85$), and alcohol (Cronbach's $\alpha = 0.86$) [10]. As reported in the ECHO trial outcome study [10], SDS score of 3 or more indicated dependence for either alcohol, poppers, or cocaine, and a score of 4 or more indicated methamphetamine dependence (see Coffin et al. [10] for further description). It should be noted that all participants were identified as 'episodic' substance-users based on frequency of drug use for purposes of eligibility, however some met criteria for

substance dependence based on the SDS scoring, which is not based on frequency.

Recent sexually transmitted infections (STI) were assessed with the following question: *Were you told by a health care provider that you had a new case of... (syphilis, gonorrhea, chlamydia, herpes, hepatitis [A, B, or C], and warts [anal or genital]) in the last six months?* If a respondent answered “yes” to any one of these statements, they were classified as having had a recent STI. HIV testing schedule was also assessed. Responses were collapsed into two categories: those who reported HIV testing every 6–12 months (consistent with CDC testing guidelines) and those either not testing on a regular schedule or a schedule longer than the recommended frequency (including every 18-months or every 24-months) or some other schedule (not specified) [18].

Risk and Risk Perception

The HIRI-MSM score is based on demographic characteristics and risk behaviors often assessed as part of HIV prevention studies. Although the HIRI-MSM was developed after this particular study was completed and retroactively applied to the data, we were able to calculate it for each participant in accordance with procedures documented in Smith et al. [3], with the exception being that we used a 3-month period rather than a 6-month period. A cut-off composite score of 10 or higher is predictive of substantial risk for HIV. Risk perception was measured using the following two questions: “*Given my current sexual behavior, I can get infected with HIV*” and “*I am worried about becoming infected with HIV.*” Response options ranged from strongly agree to strongly disagree and were recoded into two categories: agree or disagree.

For the purposes of this analysis, participants’ were initially classified into four risk-by-perception groups based on their HIRI-MSM scores and their level of agreement/disagreement with the self-perception of risk questions. The groups were: those who scored high (≥ 10) on the HIRI-MSM (substantial HIV risk) but who disagreed with both self-perception of risk questions; those who had a high HIRI-MSM score (substantial risk) and who also agreed with at least one of the self-perception of risk questions; those who had a low-HIRI-MSM score (≤ 9) and who also disagreed with both self-perception of risk questions; and those who had a low-HIRI-MSM score but who agreed with at least one of the self-perception of risk questions. As a critical public health goal is to intervene with those who may not be aware of their substantial risk for HIV, comparisons were made between those who would be screened at substantial risk for HIV acquisition based on their HIRI-MSM scores but who did not self-perceive their substantial risk (“underestimating SUMSM”) to all other participants in this

sample of at-risk SUMSM selected for their recent engagement in sexual and drug HIV risk behaviors.

Analysis Plan

The proportion of participants who fell into each risk-by-perception group was identified. Bivariate comparisons between underestimating SUMSM and the remaining at-risk cohort were conducted on sociodemographic, psychosocial, and health-related characteristics that were not used to develop the HIRI-MSM index scores. A multivariable logistic model was fit with the salient factors ($p < 0.10$) associated with the underestimation of being at substantial risk. Analyses were implemented using SAS[®] version 9.3 (SAS Institute Inc., Cary, NC).

Results

Of 326 SUMSM participants, 324 had complete available data and were included in this analysis. Demographic, psychosocial, and behavioral characteristics are presented in Table 1. Just under half of participants were white (47.2%). The majority had more than a high school or equivalent education (88.6%); and were without health insurance (67.9%) but 62.7% reported having a regular health care provider. Nearly sixty percent (59.6%) reported getting HIV tested every 6–12 months. Nealy three-quarters (70.9%) were employed full time, and 83.6% had annual income greater than \$10,000. One quarter (24.4%) had ever been incarcerated and 13.6% had ever been homeless. Nearly thirty percent (29.9%) of participants reported depression, and 42.6% met the criteria for being substance dependent according to the SDS. One hundred and eleven men (34.3%) reported recent crack/cocaine usage; 291 (89.8%) reported recent binge drinking. In addition, 25 (7.7%) reported recently exchanging sex for drugs, money or goods.

With respect to specific HIV risk related behaviors from the HIRI-MSM, in the past 90 days, 37.0% reported having 6 or more male sexual partners, 16.7% reported having at least one HIV-positive partner, 48.4% reported having at least one episode of CRAI, and 1.9% reported having five or more episodes of CIAI with an HIV-positive partner. In the 90 days prior to baseline, 9.9% reported using methamphetamines and 42.3% used poppers. Most men (90.3%) scored some points (towards the HIRI-MSM score) for age, with 38.9% falling in the age range (18–28 years) with the highest risk/point value (see Table 2 for scoring). According to Smith et al. [3] HIRI-MSM scores of 10 or higher are an indication of being at substantial risk for acquiring HIV. This characterized 214 (66%) of the total at-risk SUMSM cohort among whom more than half

Table 1 Sociodemographic, psychosocial, and behavioral characteristics (N = 324), ECHO study (2010–2012)

Descriptive variables	Distribution (N = 324) N (%)
<i>Sociodemographic characteristics</i>	
Race	
White	153 (47.2)
Hispanic/Latino	86 (26.5)
Asian/Pacific Islanders	35 (10.8)
Black	31 (9.6)
Other	19 (5.9)
Education	
High School or less	37 (11.4)
Some College or more	287 (88.6)
Employment status	
Not full-time employment	94 (40.4)
Employed (full-time)	230 (70.9)
Income	
\$0–\$9,999	44 (16.4)
\$10,000 +	280 (83.6)
Health insurance	
No health insurance	104 (32.1)
Has health insurance	220 (67.9)
Regular provider	
Yes	203 (62.7)
No	121 (37.3)
Ever homeless	
Yes	44 (13.6)
No	280 (86.4)
Tests for HIV every 6–12 months	193 (59.6)
Ever incarcerated	
Yes	79 (24.4)
No	245 (75.6)
<i>Psychosocial characteristics</i>	
Depressive symptoms	
Yes	97 (29.9)
No	227 (70.1)
Experienced racial discrimination	
More discrimination	134 (41.4)
Less discrimination	190 (58.6)
<i>HIV risk related characteristics and behaviors</i>	
Exchanged sex for drugs, money, or other goods (past 90 days)	
Yes	25 (7.7)
No	299 (92.3)
Substance dependency scale (SDS)	
Substance dependent	138 (42.6)
Not substance dependent	186 (57.4)
Reported powder/crack cocaine use (past 90 days)	
Yes	111 (34.3)
No	293 (90.4)

Table 1 (continued)

Descriptive variables	Distribution (N = 324) N (%)
Reported binge drinking (past 90 days)	
Yes	291 (89.8)
No	33 (10.1)
An STI diagnosis in past six months	
Yes	68 (21.0)
No	256 (79.0)
Diagnosed with chlamydia in past six months	
Yes	29 (9.0)
No	295 (91.0)
Diagnosed with gonorrhea in past six months	
Yes	34 (10.5)
No	290 (89.5)
<i>HIRI-MSM HIV related risk characteristics</i>	
Age N (%)	
18-28	126 (38.9)
29-40	118 (36.4)
41-48	49 (15.1)
49 +	31 (9.6)
Number of male partners (past 90 days)	
> 10	38 (11.7)
6-10	82 (25.3)
0-5	204 (63.0)
Number of positive male partners (past 90 days)	
> 1	30 (9.3)
1	24 (7.4)
0	270 (83.3)
Condomless receptive anal intercourse events with any HIV status partner (past 90 days)	
1 or more	157 (48.4)
0	167 (51.9)
Condomless insertive anal intercourse events with HIV-positive partners (past 90 days)	
5 or more	6 (1.9)
0-4	318 (98.1)
Exchanged sex for money, drugs, or other goods	
Yes	25 (7.7)
No	299 (92.3)
Used methamphetamines (past 90 days)	
Yes	32 (9.9)
No	292 (90.1)
Used poppers (past 90 days)	
Yes	137 (42.3)
No	187 (57.7)
<i>HIV risk perceptions</i>	
Concerned their sexual behavior puts them at risk for HIV	
No	231 (76.5)
Yes	93 (28.7)
Worried about becoming HIV infected	
No	248 (76.5)
Yes	76 (23.5)

of those with a score of 10 or higher: one or more CRAI events in the past 90 days (73.4%) and the recent use of poppers (50.9%) (Table 2).

Table 3 presents the number of participants in each of the risk perception by HIRI-MSM risk groups. Of the 214 SUMSM with a HIRI-MSM score of 10 or more, 147 SUMSM (68.7%, or 45.4% of the total sample) indicated that they were not concerned about their sexual behaviors putting them at risk for HIV or worried about acquiring HIV infected (Table 3). Thus, these 147 SUMSM underestimated their substantial risk for HIV as measured according to the HIRI-MSM.

In bivariate analyses, SUMSM who underestimated their substantial risk for acquiring HIV were compared to the rest of the at-risk SUMSM cohort (Table 4). The SUMSM who underestimated their substantial risk for acquiring HIV were significantly more likely to report having had an STI diagnosis in the past six months (23.7% vs. 14.7%, $\chi^2 = 8.50$, $p = 0.002$)—specifically chlamydia (16.3% vs. 5.6%, $\chi^2 = 9.75$, $p = 0.002$) or gonorrhea (13.6% vs. 5.1%, $\chi^2 = 7.15$, $p = 0.007$); exchanging sex for drugs, money, or goods (11.6% vs. 4.5%, $\chi^2 = 5.60$, $p = 0.02$), and experiencing more social isolation (63.3% vs. 52.0%, $\chi^2 = 4.17$,

$p = 0.08$). SUMSM who underestimated their substantial risk for acquiring HIV were also significantly more likely to be substance dependent based on the SDS (49.7% vs. 36.7%, $\chi^2 = 5.50$, $p = 0.02$). Those who reported experiencing more racial discrimination tended being less inclined to underestimate their high risk (36.1% vs. 45.8%, $\chi^2 = 3.12$, $p = 0.08$).

These variables, along with race, were included in the multivariable model. Although not statistically associated with group membership in the bivariate analysis, race was also included in the multivariate analysis to determine its potential impact on other characteristics such as the reporting of experiencing more racial discrimination. The

Table 3 Number of SUMSM by HIV risk perception and HIRI-MSM objective measure of risk, ECHO study (2010–2012)

	HIRI-MSM (High Risk)	HIRI-MSM (Low Risk)	Totals
High risk perception	67	89	156
Low risk perception	147*	21	168
Totals	214	110	324

*These are the SUMSM who underestimated their substantial risk for HIV

Table 2 Distribution of HIRI-MSM item values for total sample and the subsample of those who had scores of 10 or more (N = 324), ECHO study, 2010–2012

	HIRI-MSM value of response items	Total N = (324) N (%)	HIRI-MSM ≥ 10 n = 214 (66.0%) n (%)
Age N (%)			
18–28	8	126 (38.9)	101 (47.2)
29–40	5	118 (36.4)	79 (36.9)
41–48	2	49 (15.1)	21 (9.8)
49 +	0	31 (9.7)	13 (6.1)
Number of male partners (past 90 days)			
> 10	7	38 (11.7)	36 (16.8)
6–10	4	82 (25.3)	74 (34.6)
0–5	0	204 (63.0)	104 (48.6)
Number of known positive male partners (past 90 days)			
> 1	8	30 (9.3)	29 (13.6)
1	4	24 (7.4)	21 (9.8)
0	0	270 (83.3)	164 (76.6)
Condomless receptive anal intercourse events with any HIV status partner (past 90 days)			
1 or more	10	157 (48.4)	157 (73.4)
0	0	167 (51.9)	57 (26.6)
Condomless insertive anal intercourse events with HIV-positive partners (past 90 days)			
5 or more	6	6 (1.9)	6 (2.8)
0–4	0	318 (98.1)	208 (97.2)
Used methamphetamines (past 90 days)			
Yes	5	32 (9.9)	27 (12.6)
No	0	292 (90.1)	187 (87.4)
Used poppers, (past 90 days)			
Yes	3	137 (42.3)	109 (50.9)
No	0	187 (57.7)	105 (49.1)

Table 4 Differences in characteristics between SUMSM who underestimated their substantial risk for HIV and other at-risk SUMSM in the ECHO cohort, 2010–2012

Descriptive variables	SUMSM who underestimated substantial risk for HIV n = 147 (45.4%) n (%)	Other at-risk SUMSM in ECHO cohort n = 177 (54.6%) n (%)	Test Statistic χ^2	p value
Race				
White	76 (51.7)	77 (43.5)	5.63	0.16
Hispanic/Latino	41 (27.9)	45 (25.4)		
Asian/Pacific Islanders	14 (9.5)	21 (11.9)		
Black	9 (6.1)	22 (12.4)		
Other	7 (4.8)	12 (6.8)		
Education				
High School or less	17 (11.6)	20 (11.3)	0.006	0.94
Some College or more	130 (88.4)	157 (88.7)		
Employment status				
Not full-time employment	43 (29.3)	51 (28.8)	0.86	0.93
Employed (full-time)	104 (70.7)	126 (71.2)		
Income				
\$0–\$9999	26 (17.7)	27 (15.2)	0.35	0.56
\$10,000+	121 (82.3)	150 (84.8)		
Health insurance				
No health insurance	44 (29.9)	60 (33.9)	0.58	0.45
Has health insurance	103 (70.1)	117 (66.1)		
Regular provider				
Yes	91 (61.9)	112 (63.3)	0.06	0.80
No	56 (38.1)	65 (36.7)		
Ever homeless				
Yes	16 (10.9)	28 (15.8)	1.67	0.20
No	131 (89.1)	149 (84.2)		
Ever incarcerated				
Yes	31 (21.1)	48 (27.1)	1.58	0.21
No	116 (78.9)	129 (72.8)		
Depressive symptoms				
Yes	46 (31.3)	51 (28.8)	0.24	0.63
No	101 (68.7)	126 (71.2)		
Experienced social isolation				
More isolation	93 (63.3)	92 (52.0)	4.17	0.04
Less isolation	54 (36.7)	85 (48.0)		
Experiencing racial discrimination				
More discrimination	53(36.1)	81 (45.8)	3.11	0.08
Less discrimination	94 (63.9)	96 (54.2)		
Substance dependency (SDS)				
Substance dependent	73(49.7)	65 (36.7)	5.50	0.02
Not substance dependent	74(50.3)	112 (63.3)		
Used powder/crack cocaine (past 90 days)	60 (55.9)	27 (66.7)	2.46	0.12
Binged drinking on more than one day (past 90 days)	139 (93.9)	75 (85.2)	4.85	0.03
Exchanged sex for money, drugs, or other goods (past 90 days)				
Yes	17 (11.6)	8 (4.5)	5.60	0.02
No	130 (88.4)	169 (95.5)		
An STI diagnosis in the past six months				
Yes	42 (23.7)	27 (14.7)	8.50	0.002
No	105 (76.3)	150 (85.3)		

Table 4 (continued)

Descriptive variables	SUMSM who underestimated substantial risk for HIV n = 147 (45.4%) n (%)	Other at-risk SUMSM in ECHO cohort n = 177 (54.6%) n (%)	Test Statistic χ^2	p value
Diagnosed with chlamydia (past 6 months)	24 (16.3)	10 (5.6)	9.75	0.002
Diagnosed with gonorrhea (past 6 months)	20 (13.6)	9 (5.1)	7.15	0.007
HIV testing frequency				
Not on recommended schedule	63 (42.9)	68 (38.4)	0.66	0.42
Every 6–12	84 (57.1)	109 (61.6)		

Table 5 Multivariable analyses with adjusted odds ratios (AOR) for predictors of underestimating substantial risk for HIV acquisition, ECHO study, 2010–2012

Predictors	AOR (95% CI)	p-value
Race	0.87 (0.70–1.07)	0.18
Recently exchanged sex for drugs, money, or other goods	2.56 (1.01–6.45)	0.047
Had a recent STI diagnosis	2.34 (1.32–4.12)	0.003
Experienced more social isolation	1.62 (1.01–2.60)	0.046
Substance dependent	1.54 (0.97–2.46)	0.068
Experiencing more racial discrimination	0.65 (0.39–1.09)	0.103

multivariable model (Table 5) indicated the following significant independent predictors of underestimating one's substantial risk for acquiring HIV: in the past 90 days exchanging sex for money, drugs, or other goods (AOR = 2.56 [95% CI 1.01, 6.45], $p = 0.05$), reporting an STI diagnosis (AOR = 2.34 [95% CI 1.32, 4.12], $p = 0.003$), and experiencing more social isolation (AOR = 1.62 [95% CI 1.01, 2.60], $p = 0.04$).

Discussion

As might be expected based on sample selection, two-thirds of this at-risk SUMSM sample were classified as being at substantial-risk for HIV by the validated HIRI-MSM screener. Despite HIV risk behaviors, over two-thirds (69%) of those at substantial risk were not concerned or worried about getting HIV, underestimating their HIV risk relative to that of the objective assessment. Of the characteristics and behaviors examined here, the following were significantly associated with underestimating substantial risk: (1) reporting an STI diagnosis in the past 6 months (and specifically, chlamydia and gonorrhea); (2) experiencing social isolation; and (3) exchanging sex for money, drugs or other goods. Substance dependency and experiencing more racial discrimination were not found to be independent predictors of underestimating substantial HIV acquisition risk in multivariable analysis.

The discordance between risk perception and actual risk may be due to one of several factors. First, it is possible that SUMSM actually knew the characteristics and behaviors that increase risk for HIV, but just did not know the extent to which high-risk characteristics or behaviors contributed to their personal risk, or how to cognitively estimate that risk [19, 20]. Tools such as CDC's Risk Reduction Tool (<https://wwwn.cdc.gov/hivrisk/>), a customizable calculator which helps individuals better understand how specific risk or protective behaviors increase or decrease an individual's risk of acquiring HIV, may help people to more accurately understand and estimate their personal HIV risk. A second factor may have been a history of repeated negative HIV test results, which have been associated with confidence about remaining seronegative and presumably less worry or concern about personal risk [4, 21, 22]. Nearly 60% of men in our sample said they were testing for HIV on a regular basis every 6–12 months.

HIV testing history may also be related to the association between a recent STI diagnosis and underestimation of substantial HIV risk. Findings suggest that because of extenuating biological factors, MSM with recent STI diagnoses (such as gonorrhea, syphilis, and chlamydia) were more likely to contract HIV following their STI diagnosis as compared to MSM overall [23–25]. It is possible that in this sample of men at risk for HIV, those who recently had a STI diagnosis also received a concomitant HIV negative test result, which may have lead them to be less worried or concerned about HIV. Furthermore, some may have begun changing their risk behaviors since their recent STI diagnosis, and thereby were less worry or concerned about HIV. Without additional information as to the exact timing of participants' STI diagnosis (that is, whether it was more recent or distal to completion of the baseline assessment), it is not possible to know whether or to what extent the timing of the STI diagnoses influenced HIV risk perceptions or potentially modified behaviors.

Engaging in sex exchanging (for drugs, money, or other goods), and social isolation, were also predictors of underestimating substantial risk. Engaging in sexual exchange is a high risk activity; underestimating this risk may reflect a cognitive strategy designed to avoid distress over this very

high-risk threat to health, particularly if the alternative is going without necessities such as food or shelter [26–28]. There is some limited evidence for this cognitive strategy in other sex exchanging population [27]; further research may examine whether this strategy is used by SUMSM. It is unclear why social isolation is associated with underestimating substantial HIV risk. It could simply relate to a lack of information about risk and protective factors that are communicated through public health messaging targeted to the LGBT community and shared through networks of men identified with the community, or it may reflect less accuracy in perceived norms about risk and protective behaviors among one's network of partners [29, 30]. Adoption of safer sex practices has been associated with perceived social and normative support for HIV risk reduction activities among gay men [31–33]; these perceptions may lean towards greater distortion (for example, less accurate beliefs about community norms for protective behaviors) for more socially isolated men.

This study has several limitations. First, these data were obtained from SUMSM living in San Francisco who were eligible and who agreed to participate in a randomized controlled trial testing the efficacy of an HIV risk-reduction intervention. Due to specific eligibility criteria, self-selection bias into the trial, and lack of geographic diversity, our findings may not be generalizable to all SUMSM, let alone all MSM. In addition, the original study [10] was not established to analyze the HIRI-MSM screener [3]. The original HIRI-MSM measures risk behaviors over the six months prior to data collection whereas the current study was initially designed to assess behavior in the three months prior to baseline. Thus, our measure may have underestimated the number of SUMSM within our sample who could have been classified as at substantial risk for acquiring HIV based on their behavior for six months prior to baseline in accordance with the original HIRI-MSM.

These limitations notwithstanding, this is among the first applications of the HIRI-MSM as a screener providing an objective measure of substantial risk for HIV acquisition among MSM. Two screening studies and one modeling study have been reported [34–36]. Our results complement those presented in a recent Canadian study examining the “optimal” MSM candidates for pre-exposure prophylaxis (PrEP) showing underestimation of objectively measured risk among some MSM, which like in our sample characterizing about 2/3 of MSM as being at substantial risk [34]. This study demonstrated that considering indicators of underestimated risk, and using standardized screening questions may result in fewer missed opportunities for early intervention.

In a US study, the HIRI-MSM has been shown to also be cost-effective in the roll out PrEP [36]. PrEP has been proven to be a highly effective biomedical prevention

option for HIV-negative persons whose sex and/or drug use behaviors place them at substantial risk for acquiring HIV [37–39]. Current literature including the other US study which used HIRI-MSM in its cost analyses, show prioritizing sub-populations of groups like MSM who may engage in at-risk behaviors can be cost-effective in reducing HIV incidence [36, 40, 41]. For SUMSM who may not want or be able to use PrEP, efficacious behavioral prevention interventions are available and proving useful to reduce HIV risk among MSM, including SUMSM. Personal Cognitive Counseling (PCC), the single-session, risk-reduction intervention tested with this cohort, is designed to have MSM focus on self-justifications for engaging in sexual risk taking [42]. The HIRI-MSM screener can be a useful tool for providers to help SUMSM better understand their personal HIV risk behaviors and consider risk-reduction solutions such as PrEP, PCC or other behavioral interventions as ways to avoid HIV infection.

Conclusion

A recent STI diagnosis, along with patient reports of social isolation or sexual exchange for drugs, money, or other goods, may indicate a need for immediate and frank discussion about personal risk for acquiring HIV. Screening will be a good start, but more is needed to understand how self-perceptions of HIV risk are formed, influenced, and how they can be changed to improve prevention.

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Compliance with Ethical Standards

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Conflict of interest The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the Centers for Disease Control and Prevention and the University of California San Francisco (UCSF) committee on Human Research and with the 1964 Helsinki declaration and its later amendments or com-

parable ethical standards. This article does not contain any studies with animals performed by any of the authors.

Informed consent Informed consent was obtained from all individual participants included in the study.

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