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ORIGINAL ARTICLE

Do Assessments of HIV Risk Behaviors Change Behaviors and Prevention Intervention Efficacy? An Experimental Examination of the Influence of Type of Assessment and Risk Perceptions

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Abstract
Background Behavioral assessments may change behaviors and responses to behavioral interventions, depending on assessment type and respondents' motivations.
Purpose We observed effects on sexual behavior and human immunodeficiency virus (HIV) prevention intervention efficacy of interviews assessing recent HIV risk behavior frequency or HIV risk behavior events among respondents with different perceptions of their risk for HIV.
Methods Young South African sexually transmitted infection (STI) clinic clients (N=1,728) participated in a 3 (event-based vs. frequency-based vs. no interview) by 2 (evidence-based vs. standard of care risk-reduction session) RCT.
Results The interviews increased reported safer sexual behavior among youth with higher but not lower risk perceptions. The intervention session was less effective when combined with interviews, particularly among lower risk perception youth. Patterns replicated for both interviews.
Conclusions HIV risk behavior assessments may increase resistance to interventions among unmotivated youth and enhance safer sexual behavior among motivated youth. Behavioral assessments may reduce HIV risk among motivated individuals.

Keywords HIV prevention interventions · Assessment reactivity · Motivation · Randomized controlled trials

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Introduction

Reducing sexual risk behavior remains an effective means of preventing new human immunodeficiency virus (HIV) infections. Interventions that increase knowledge, motivation, and behavioral skills can reduce sexual HIV risk. More than 20 meta-analyses have summarized the effect of such interventions, identifying changes as high as 40 % in safer sex [1, 2] and reductions in HIV and other sexually transmitted infections [2–4].

Evidence on the effectiveness of HIV behavioral interventions stems from hundreds of randomized clinical trials (RCTs). In a RCT, interventions are typically preceded by assessments of baseline risk behaviors and their psychosocial correlates. These baseline self-report assessments are assumed to elicit people's opinions and behaviors without influencing study outcomes, which are attributed to the intervention. Evidence suggests that assessments may induce thought processes that affect behavior and people's responses to behavioral interventions [5–8]. This phenomenon has been labeled pretest sensitization [9] and assessment reactivity [10]. These concepts imply

that self-reporting behavior-related information may change people's motivations and behaviors and eventually influence the efficacy of the behavioral change interventions that are applied after the behavioral self-reports.

Despite awareness about assessment reactivity, little attention has been given to HIV behavioral assessments as sources of motivation and behavioral change. Understanding this influence is necessary to untangle conditions that facilitate behavior change when assessments are included in intervention strategies (e.g., motivational interviewing) [11] and minimize it in HIV prevention intervention RCTs so that assessments do not influence study outcomes. This study sets out to determine if different assessments of HIV-related behaviors affect sexual risk behaviors and the efficacy of behavioral interventions at reducing sexual risk for HIV.

How May Assessments of Sexual Behavior Affect Behavior and the Efficacy of Behavioral Interventions at Reducing Sexual Risk for HIV?

Two lines of research have examined the influence of behavioral assessments on behaviors and associated motivations. A first line suggests that reporting behavior-related information may increase motivation to repeat past behaviors and resistance to persuasion [12]. Thus, people often infer their motivations from the way they have behaved rather than from the way they feel or think [13]. Asking people about their past risk behaviors may induce people to infer risk-congruent motivations. Reporting behavior-related information may also make behaviors more stable and resistant to change through increased accessibility and confidence of the associated motivations [8, 14]. Because risk behaviors are not unambiguously negative (e.g., unprotected sex is risky *and* pleasant), this can occur regardless of the behavior's negative consequences. Individuals who completed a questionnaire on their intentions to donate blood were more likely to register to donate blood at 6-month follow-up than those who did not complete the questionnaire [15, 16]. However, drug users who communicated their intentions to use illegal drugs also reported more frequent use of illegal drugs two months later than those who did not [17]. From this point of view, questions meant to assess unhealthy behaviors for prevention may paradoxically strengthen preexisting risk motivations and hinder change following HIV prevention interventions.

A second line of research views behavioral assessments as opportunities to reflect upon a behavior and the degree to which it may affect one's well-being. From this perspective, assessments can change motivations and induce more thorough participation in interventions applied shortly after the assessments or integrated with them in clinical applications [18]. For example, female Marines who reviewed their sexual behavior using a calendar-based questionnaire increased perceptions of vulnerability to HIV infection [19] as did individuals who completed a questionnaire that used memory cues to assess their sexual behavior [20]. Additional evidence comes from HIV prevention RCT control groups which typically receive minimal intervention but thorough assessments of risk behavior [5, 21]. A meta-analysis of HIV prevention interventions showed a significant increase in condom use in control groups (d=0.09), with supplementary analyses identifying moderate improvements in control groups with higher numbers of partners [1].

Researchers from both lines of inquiry have pointed to the conditions that may facilitate change following behavioral assessments. First, research suggests that the impact of behavioral assessments on behaviors depends on the *assessment situation*. For example, increases in risk-reduction motivations have been associated with more personalized assessment contexts. Kalichman and colleagues [22] found that a sexual behavior assessment delivered in either a face-to-face or self-administered questionnaire resulted in greater intentions to reduce risk behavior than the same assessment administered in groups with the aid of an overhead projector. Motivation to reduce risk behavior was also related to completing measures that are more personalized or tailored to the respondents' circumstances and behaviors. Weinhardt [20] administered two types of assessments to participants randomized to conditions. These involved a more general frequency-based interview in which participants estimated how often they engaged in each of the risk behaviors presented in a list and a more personalized event-based interview in which, using a calendar, they recalled specific sexual behavior episodes and the particular context in which each of them occurred. The event-based interview resulted in greater increases in safer behavior intentions than the frequency-based interview. Presumably, more personalized event-based recall produces a greater sense of the self as the actor of the behavior and involvement in the assessment process than more general frequency-based recall [23].

Second, the effects of assessments have been associated with *respondents*' *motivations* with regard to the behavior in question. Compared with people who do not, people who report that they intend to perform a behavior are more likely to perform that behavior at a later time [7, 16], as do people who self-report behaviors that are socially desirable [24]. Research has been less clear about the assessment of behaviors with positive and negative implications, like those that convey risk for HIV. Overall, when behaviors are bivalent, studies indicate that the valence of the behaviors' affective—versus cognitive—aspects takes precedence, particularly for hedonic actions (e.g., drinking, having sex) [12, 14, 17, 25]. However, research also suggests that greater involvement or motivation may increase cognitive processing during the assessment and consideration of the behaviors' more rational implications [26]. Thus, women with higher perceived risk of being HIV positive reported more processing of, and

receptivity to, information about the likely health effects of not taking an HIV test [27], presumably because high risk perceptions motivate people to avoid further risks [28].

Together these findings may explain apparent contradictions on the impact of assessments on behavior. On one hand, reporting one's sexual behaviors may highlight the behavior's positive affective implications and hinder behavior change [29]. On the other, factors that increase cognitive processing during the assessment can prompt people to consider the more rational negative outcomes of the behavior and enhance behavior change [25, 29].

The Present Study

Despite that the aforementioned research suggests that behavioral assessments are not innocuous, research on the effects of assessments on HIV-related behaviors is scarce. Moreover, research in other substantive domains has been insufficient to resolve the apparently contradictory findings regarding behavioral self-reports [6]. Studies have examined the effect of assessing people's intentions instead of their behaviors [6, 7, 15, 17, 29] and reactivity to measures of behaviors with relatively univalent positive *or* negative implications (e.g., donating blood, exercising) [30, 31]. Research with behaviors with bivalent implications, mostly on substance use, has seldom explored conditions for assessment reactivity other than assessment comprehensiveness or repetition [5, 32–35]. In these cases, some studies have found risk reduction [36, 37] and others identified reductions only in certain outcomes or for specific populations [36–40].

We conducted a RCT in a high HIV prevalence community. We observed if assessments of HIV-related behaviors influenced HIV risk behaviors and if they affected the efficacy of an HIV risk-reduction counseling session implemented after the assessments. We particularly observed if greater involvement in the assessment, induced either by a personalized assessment or participants' perception of their possibility of getting infected with HIV reduced sexual risk for HIV and enhanced the impact of an HIV prevention counseling session on HIV risk behaviors. Because of enhanced processing of the health implications of the behavior, we presumed that *motivational and contextual* conditions that increase involvement in a sexual behavior assessment (i.e., higher risk perceptions and completing a personalized event-based interview) would be associated with lower risk behavior and greater efficacy of the counseling session at reducing HIV risk. In turn, because of the dominance of the positive automatic affective motivations, we expected that conditions that promote lower involvement in the assessment (i.e., lower risk perceptions and completing a general frequency-based interview) would not be associated with decreases in risk behavior or enhanced intervention impact. Our study hypotheses were:

Hypothesis 1 Completing an *event-based interview* will (a) increase safer sexual behavior and (b) enhance the efficacy of a counseling session at reducing HIV risk. Thus, (a) youth completing an *event-based interview* will report safer sexual behavior than those who do not, and (b) youth completing an event-based interview before a risk-reduction counseling session will report safer sexual behavior than those completing the counseling session alone.

Hypothesis 2 Completing a *frequency-based* interview will (a) increase safer sexual behavior and (b) enhance the efficacy of a counseling session at reducing HIV risk when respondents have higher risk perceptions at the time of the interview. Thus, (a) youth completing a *frequency-based* interview will report safer sexual behavior than those who do not *only* when they have higher risk perceptions at the interview, and (b) youth completing a frequency-based interview before a risk-reduction counseling session will report safer sexual behavior than those completing the session alone, *only* when they have higher risk perceptions at the interview.

Method

We conducted a gender blocked randomized controlled trial with 1,728 black South African youth attending a sexually transmitted infection (STI) clinic in Khayelitsha, South Africa. Khayelitsha, a black township near Cape Town, has an estimated antenatal HIV prevalence of 33 %, compared with the 30 % antenatal prevalence of the country [41]. The study was registered in ClinicalTrials.gov, number NCT01580657.

Study Design

The study design is depicted in Fig. 1. Eligible clients provided their written informed consent and answered a short questionnaire with demographic and socio-cognitive measures, and were randomly assigned to complete either an event-based behavioral interview (e.g., "identify and describe each of your sexual encounters using a three-month calendar"), a frequency-based behavioral interview, (e.g., "With how many partners have you had sex in the last three months") or were assigned to complete no interview. Clients in each of the three interview conditions were then randomized to receive the standard informational HIV prevention session conducted at the clinic (i.e., standard of care-session condition) or the standard session and an evidence-based HIV prevention

session tailored to South Africans receiving services in STI clinics (i.e., evidence-based session condition) [42]. These procedures resulted in six conditions: four with either a frequency or event-based interview combined with or without the evidence-based session and two with or without the evidence-based session but with no interview (see Fig. 1). Three months after randomization, youth completed an audio-assisted computerized survey on their sexual behavior, which was more personalized than the frequency-based interview but not as detailed as the event-based one. A computerized versus a face-to-face questionnaire was used to reduce the advantage of practice for youth who completed the baseline interviews versus those who did not.

Procedures

Study procedures were approved by the institutional review boards of the involved institutions. STI clinic clients were briefed about the study and referred to the study staff for screening. They were eligible if they were ≥ 18 years old, were not HIV positive, had been sexually active in the previous three months, and had received STI treatment or voluntary counseling and testing in the clinic. Eligible clients scheduled an appointment with a same-gender interviewer within 8 days. Figure 2 shows the numbers of participants who were screened, eligible, enrolled, and randomized to study conditions.

Experimental Manipulations

Baseline behavioral interviews

Event-based interview condition Participants responded to the HIV-risk timeline follow-back interview [20], which asks participants to detail the occasions in which they had sex (anal or vaginal) during the last three months using a calendar. In the calendar, participants indicate each sexual intercourse occasion, the type of partner involved (primary or secondary), partner characteristics (e.g., perceived age, HIV status), and details of the sexual situation (whether negotiation of condoms occurred, whether alcohol or drugs were involved, and whether condoms were used).

Frequency-based interview condition Participants responded to 27 single-item frequency-based questions about their sexual behaviors in the past three months (e.g., "How many times have you had sex using condoms in the last three months?") Participants reported the number of occasions of each behavior, or zero if none.

Intervention sessions

Standard of care session condition Participants in this condition received the standard of care session applied to all clinic patients, which consists of basic information about HIV and STI.

Evidence-based session condition Participants assigned to the evidence-based session received the standard of care session plus a 60-min risk-reduction counseling session developed for South African STI clinic clients. The session is based on the social cognitive theory [43] and motivational interviewing techniques [11] and has reduced HIV risk in previous studies in similar settings (see Kalichman et al. (2011) for details about the evidence-based session) [42].

Assessment Procedures and Measures

Baseline assessment Before randomization to experimental conditions, all participants completed a brief demographic and socio-cognitive assessment with the following measures:

Demographics Participants reported their age, level of education, housing status, and religion. Youth also responded if they worked or studied and if they had a stable partner.

Safer sex behavioral intentions Youth responded to two items assessing intentions to engage in safer behaviors. They were asked: "Is it likely or unlikely that you will use a condom when you have sex in the next three months?" Those who responded that it was likely (unlikely) were then asked "it is very, somewhat, or a little likely (unlikely)?" Also, participants were asked: "Are you willing to have one sexual partner in the next year? Those who reported being willing (unwilling) to have a monogamous partner were then asked to report how willing (unwilling) they were. Answers were used to construct −3 to +3 safer sex intention items.

HIV risk perceptions We assessed risk perceptions with two items scored on six-point scales from "no risk" to "very high risk." Items asked participants about their risk for HIV infection based on their behaviors in the past 3 months. The two items were highly correlated (r=.57, p<.001; Cronbach's Alpha=.73) and averaged. The median of the averaged items was the scale mid-point and was used to create groups of higher and lower risk perception participants.

Follow-up assessment Three months after randomization, participants returned to complete audio-computerized measures of risk behavior. The questionnaire asked about the number of partners with whom they have had sex, whether the partners were primary or secondary, and whether they were HIV positive. Participants reported the number of times they have had sex with main and secondary partners, and the number of times they had used condoms with primary and secondary partners in the previous 3 months. These measures were developed for the evaluation of the evidence-based

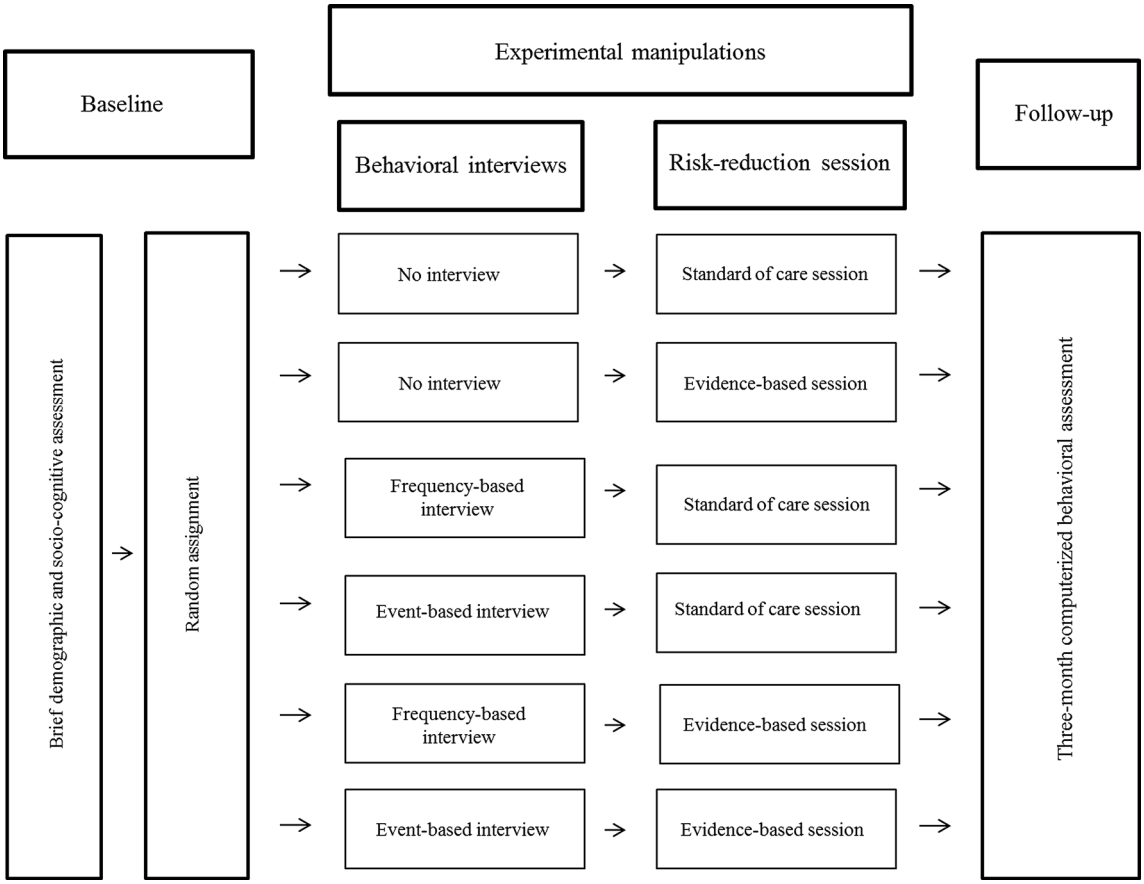

Fig. 1 Study design and description of experimental conditions

session used in this study and had been applied to South African STI clinic patients [42]. Given that sexual behavior with main and secondary partners confer HIV risk in a generalized epidemic, the effects of the manipulations and risk perceptions were observed on reported number of partners, mean proportions of condom use with primary and secondary partners, and rates of youth who had 100 % protected sex with secondary partners.

Data Analyses

We used ANOVAs and χ^2 tests to compare groups in demographics and socio-cognitive measures and, among youth who received behavioral interviews, risk behaviors. We conducted generalized linear models to observe main effects and interactions among the independent variables on 3-month follow-up reports of sexual behavior, namely, number of partners and condom use. We fitted linear models for mean proportions of condom use and a binary model for having 100 % protected sex with secondary partners. For number of partners, we fitted a negative binomial model to account for the variability in the data. Models were fit in two steps. In the first, we entered the main effects to observe the impact of the interviews and the intervention; in the second, the two- and three-way interactions for hypotheses testing. Three-way interactions were retained in the model if they were significant at $p<.1$.

To determine if youth who completed the event-based interview reported lower sexual risk for HIV (hypothesis 1a), we observed the main effect of the event-based interview on three-month reports of number of partners and condom use. To observe if youth who completed the event-based interview before the evidence-based session reported lower sexual risk than those completing the session alone (hypothesis 1b), we observed the interaction between the evidence-based session with the event-based interview on the aforementioned outcomes. Similarly, to determine if youth who completed the frequency-based interview reported lower sexual risk for HIV *only* if they had higher risk perceptions (hypothesis 2a), we observed the interaction between the frequency-based interview and risk perceptions on the three-month reports of number of partners and condom use. To observe if youth who completed the frequency-based interview before the evidence-based session reported lower sexual risk for HIV than those completing the session alone *only* if they had higher risk perceptions (hypothesis 2b), we observed the interaction of the evidence-based session with the frequency-based interview and risk perceptions on the same outcomes. In all cases, we controlled for pretest safer sex intentions because they

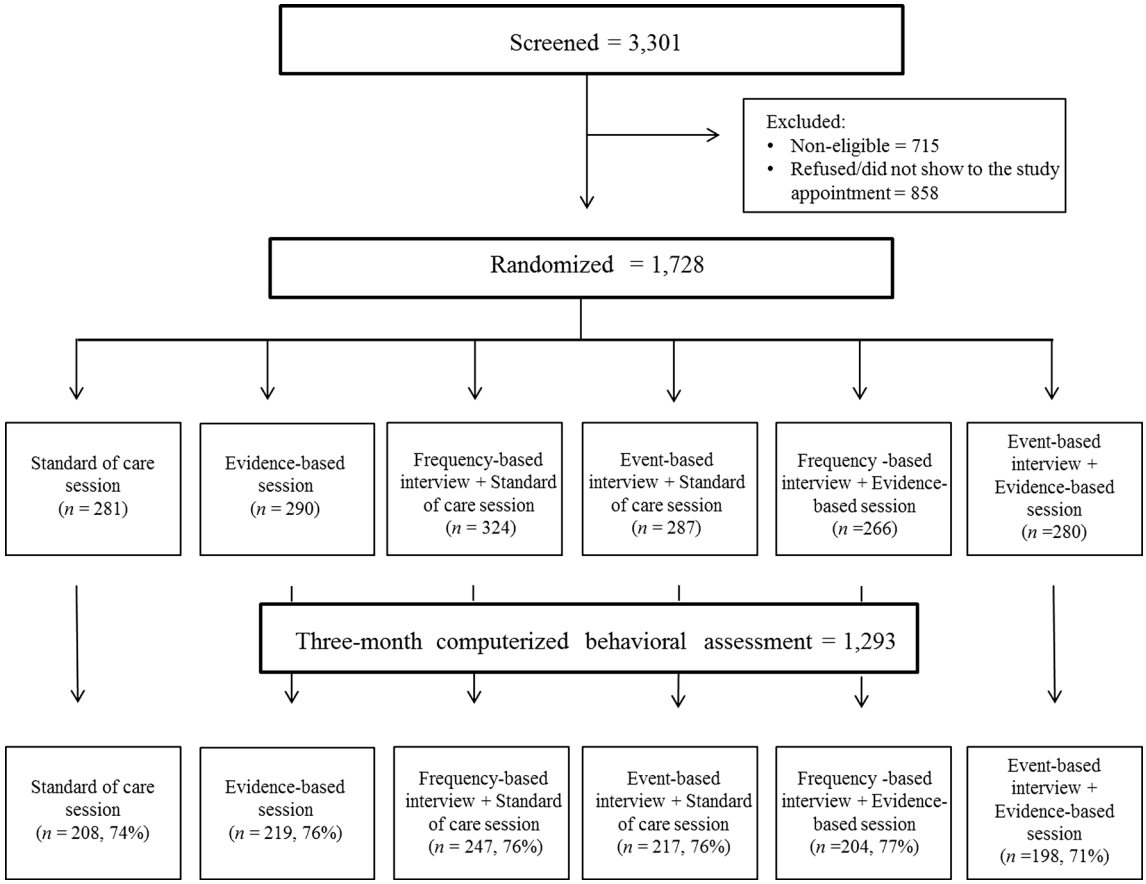

Fig. 2 Participants screened, enrolled, randomized, and retained in the study

were related to baseline risk behavior in the conditions with interviews, and we could not control for actual baseline risk. Because intention items were not correlated, the condom use intention item was used as a covariate in condom use models and the single partner intention item in the number of partners' model.

To interpret significant interactions, we conducted custom comparisons and calculated raw differences between groups. Model fit was determined with the likelihood ratio chi square which compares the fitted against the intercept model.

Results

Table 1 shows the characteristics of the sample in terms of demographics, socio-cognitive measures, and risk behavior (the latter among the behaviorally assessed groups). Participants were young, more than half had not completed the South African equivalent of high school, and nearly 40 % neither worked nor studied. Nearly half of the participants (43 %) belonged to an independent African or a Zionist church, 28 % were Christian, 16 % practiced traditional African religions, and 10 % reported having no religion (data not shown). More than half of the participants lived in formal housing units, 12 % resided in shacks, and 25 % were homeless or had an unstable housing situation. Youth had relatively positive safer sex intentions and moderate perceptions of HIV risk with mean and median risk perceptions surrounding the scale middle point.

Youth who completed the interviews reported a mean of 1.7 partners in the preceding 3 months, with nearly 40 % of them reporting having had more than one partner during that period. Pretested youth had used condoms 55 % of the times they had sexual intercourse. Percentages of condom use were similar in terms of partner type (53 vs. 63 % for main and secondary partners, respectively). Men reported more partners than women (F (1, 1,133)=93.75, $p<.001$), but there were no gender differences in condom use. Nearly a third of the youth who reported multiple partners in the groups that completed the interviews reported lower risk perceptions. ANOVAs and χ^2 tests and pairwise contrasts showed that groups were equivalent in most of these measures. However, youth in the frequency-based interview group were slightly more educated than those in the event-based interview/evidence-based session group (10.9 vs. 11.2, $p<.05$).

Retention rates ranged from 71 to 76 % (see Fig. 2). There were no differences in retention in terms of gender, age, risk perceptions, safer sex intentions, and, in conditions with

baseline interviews, risk behaviors. Youth who completed the follow-up were slightly more educated than those who did not (M=10.9 vs. 11.1, F (1, 1,723)=13.40, p<.001). Retention did not affect the experimental group's equivalency in the variables observed at baseline.

Effects of the behavioral interviews and the evidence-based session The first panel of Table 2 shows the main effects of the interviews and the evidence-based session on the sexual behavior reported at follow-up. Youth who received the evidence-based session reported fewer partners, higher condom use, and 100 % protected sex with secondary partners than those who did not. Youth who responded and did not respond to the event- or frequency-based interviews did not differ in the sexual behavior they reported at follow-up.

Effects of risk perceptions and behavioral interview type on sexual risk behavior The lower panel of Table 2 shows the models with the interactions between risk perceptions and the manipulated conditions. As stated in hypothesis 2a, there were significant frequency-based interview by risk perceptions interactions for condom use reports with secondary partners and for rates of youth who had 100 % protected sex with secondary partners. There was also a three-way interaction for condom use with primary partners, in which the interaction between frequency-based interview and risk perceptions was significant *only* among participants who did not receive the evidence-based session. However, unlike stated in hypothesis 1a, the effect of the event-based interview on safer sexual behavior was exactly the same. The upper panel in Fig. 3 depicts the interactions, which show that both interviews followed the pattern predicted in Hypothesis 2a. Youth with lower risk perceptions who completed *either* interview reported the same or lower condom use and rates of 100 % protected sex with their secondary partners than youth with lower risk perceptions who did not complete any interview. Conversely, youth with higher risk perceptions completing *either* interview reported improved condom use with primary and secondary partners compared with those who did not complete them. The observed increases in 100 % protected sex with secondary partners in the interview groups were non-significant. (The figure presenting condom use with primary partners excludes the cases in the evidence-based session because the two-way interaction was not significant in this group.)

Effects of risk perceptions and behavioral interview type on the efficacy of the evidence-based session at reducing sexual risk behavior We next observed the effects of completing the behavioral interviews on the efficacy of the risk-reduction evidence-based session. Unlike our prediction that completing the event-based interview would enhance the efficacy of the evidence-based session at reducing risk behavior among all youth (hypothesis 1b) and completing the frequency-based interview would not (hypothesis 2b), completing either the event or the frequency-based interview had the same unexpected effect on the efficacy of the evidence-based session at reducing sexual risk behavior. As shown in the interactions depicted in Fig. 3, youth who completed either interview before the evidence-based session reported *lower*—rather than higher—condom use than those who completed the evidence-

Table 1 Description of the sample and comparison of experimental groups at baseline

	Baseline interviews+ evidence- based session		Evidence-based session	Baseline interviews+standard of care session		Standard of care session	χ^2/F
	Event-based n=280	Frequency-based n=266	n=290	Event-based n=287	Frequency-based n=324	n=281	
M (SD) age	20.8 (1.98)	20.6 (1.95)	20.7 (2.11)	20.5 (1.81)	20.7 (1.92)	20.8 (2.06)	1.06
M (SD) years of education	11.1 $(1.28)_a$	11.0 (1.21)	11.0 (1.57)	11.0 (1.68)	10.9 $(1.89)_b$	11.0 (1.03)	1.16
N (%) female	153 (55 %)	142 (53 %)	156 (54 %)	140 (49 %)	156 (48 %)	155 (55 %)	5.58
N (%) without a regular activity	112 (40 %)	108 (41 %)	121 (42 %)	113 (40 %)	127 (40 %)	106 (38 %)	1.15
M (SD) condom use intentions (−3/+3)	2.0 (1.60)	2.0 (1.72)	2.2 (1.55)	1.9 (1.77)	2.0 (1.68)	2.1 (1.60)	0.87
M (SD) single partner intentions (−3/+3)	1.7 (2.00)	1.6 (1.94)	1.6 (1.99)	1.5 (2.09)	1.4 (2.20)	1.7 (1.98)	0.99
M (SD) risk perceptions (1–6)	3.2 (1.43)	3.0 (1.49)	3.0 (1.49)	3.1 (1.45)	3.2 (1.44)	3.2 (1.48)	0.86
M (SD) n sexual partners	1.6 (1.05)	1.7 (1.47)	–	1.6 (1.17)	1.8 (2.15)	–	1.05
N (%) had more than one partner	102 (37 %)	102 (39 %)	–	110 (39 %)	121 (39 %)	–	0.30
M (SD) % condom use with main partners	49 (43)	54 (37)	–	49 (43)	51 (33)	–	0.53
M (SD) % condom use with secondary partners	59 (39)	62 (38)	–	59 (40)	66 (38)	–	1.04
N (%) 100 % protected sex with secondary partners	48 (33 %)	40 (37 %)	–	47 (35 %)	52 (4 %)	–	1.74

Different subscripts indicate significantly different means at p<.05

Table 2 Generalized linear models: effects of risk perceptions and experimental manipulations on reported number of partners and condom use

	Number of partners (n=1,288)			Condom use primary partner (n=929)			Condom use secondary partners (n=640)			100 % condom use secondary partners (n=640)		
	B	*SE*	Wald χ^2	*B*	*SE*	Wald χ^2	*B*	*SE*	Wald χ^2	*B*	SE	Wald χ^2
Model 1: main effects												
Intercept	1.19	0.06	414.11***	0.60	0.03	471.60***	0.61	0.04	300.16***	0.02	0.19	0.01
Safer sex intentions	−0.12	0.01	101.78***	0.06	0.01	86.62***	0.03	0.01	19.04***	0.07	0.04	4.28*
Risk perceptions	0.23	0.05	19.47***	−0.07	0.02	11.35***	0.07	0.03	5.64*	0.05	0.16	0.09
Evidence-based session	−0.32	0.05	40.06***	0.05	0.02	4.61*	0.07	0.03	6.15*	0.49	0.16	9.03**
Baseline interviews												
Event-based	0.03	0.06	0.22	−0.40	0.03	1.89	0.01	0.04	0.07	−0.16	0.20	0.66
Frequency-based	−0.05	0.06	0.70	−0.2	0.03	0.49	−0.01	0.03	0.07	−0.14	0.20	0.52
Model 2: main effects+interactions												
Intercept	1.19	0.10	225.26***	0.62	0.04	267.77***	0.62	0.05	169.29***	0.02	0.26	0.00
Safer sex intentions	−0.12	0.01	103.61***	0.06	0.01	89.93***	0.03	0.01	18.56***	0.09	0.03	5.43*
Risk perceptions	0.34	0.10	11.33**	−0.26	0.06	21.93***	−0.07	0.06	1.62	−0.56	0.33	2.84+
Evidence-based session	−0.39	0.10	14.72***	0.03	0.05	0.17	0.17	0.06	9.78**	1.12	0.34	10.66**
Baseline interviews												
Event-based	0.07	0.10	0.42	−0.06	0.05	0.14	0.02	0.06	0.07	−0.29	0.34	0.73
Frequency-based	−0.10	0.10	0.92	−0.04	0.05	0.63	−0.01	0.06	0.02	−0.15	0.34	0.19
Evidence-based session × baseline interviews												
Evidence-based session × event-based	0.08	0.13	0.40	−0.08	0.06	1.26	−0.19	0.07	7.91**	−0.81	0.41	3.83*
Evidence-based session × frequency-based	0.21	0.13	2.76+	−0.04	0.07	0.13	−0.19	0.07	8.02**	−0.98	0.41	5.82*
Evidence-based session × risk perceptions	−0.07	0.10	0.46	0.12	0.03	19.24***	0.05	0.06	0.63	−0.06	0.33	0.03
Baseline interviews × risk perceptions												
Event-based × risk perceptions	−0.15	0.13	1.34	0.14	0.13	1.19	0.17	0.07	6.35*	0.99	0.41	5.78*
Frequency-based × risk perceptions	−0.10	0.12	0.59	0.08	0.12	1.35	0.18	0.07	7.37**	0.88	0.40	4.77*
Evidence-based session × baseline interviews × risk perceptions												
Evidence-based session × frequency-based × risk perceptions	–	–	–	−0.22	0.11	4.17*	–	–	–	–	–	–
Evidence-based session × event-based × risk perceptions	–	–	–	−0.25	0.10	5.78*	–	–	–	–	–	–
Model likelihood ratio χ^2			186.16***			129.18***			49.31***			28.47***

Different *ns* in the analyses reflect that different numbers of individuals reported having main and secondary partners

*p<.05, ** p<.01, ***p<.001, + p <. 10

session without the interviews. Moreover, unlike we expected in hypothesis 2b, the three-way interaction of the evidence-based session, the frequency-based interview, and risk perception was only significant for condom use with main partners. Even in this case, completing the frequency-based interview did not enhance the efficacy of the evidence-based session at reducing HIV risk among high risk perception youth as it was predicted

Exploring the effects of risk perceptions, interview type, and evidence-based session on risk behavior In our study, the evidence-based session was less effective at reducing sexual risk behavior when it was preceded by any of the interviews. However, risk perceptions moderated the interviews' effects on sexual risk behavior. To disentangle the two interactions, we conducted post hoc exploratory analyses in which we estimated, *within* each risk perception group, the differences in safer behavior between youth in each experimental condition and youth in the standard of care group. These analyses also allowed for exploring differences between the effects of the interviews and the evidence-based session on sexual risk behavior relative to the standard of care group. The three panels of Fig. 4 show the percentages of condom use and rates of youth with 100 % protected sex with secondary partners in each condition within each risk perception level, as well as the raw intergroup differences for significant

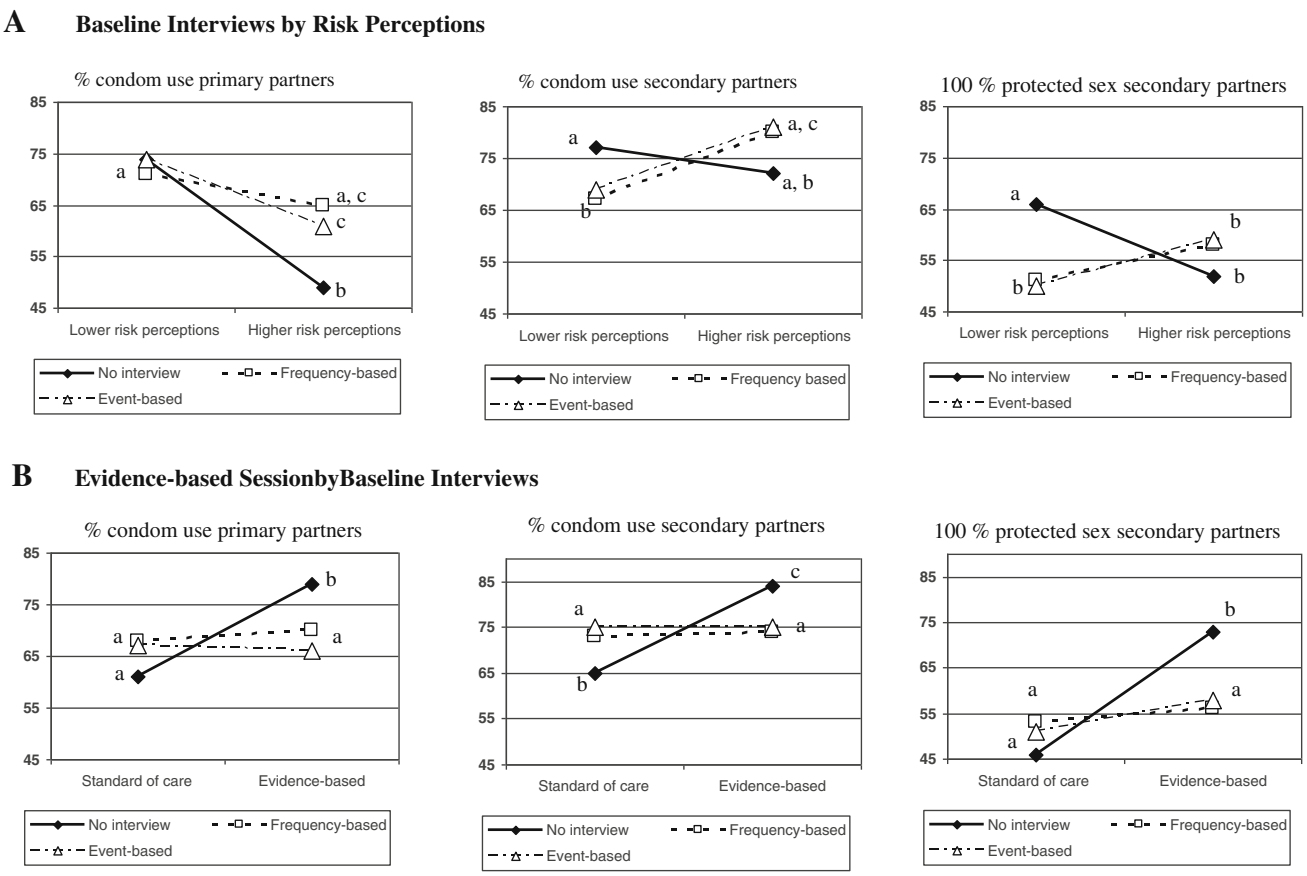

Fig. 3 Two-way interactions between the baseline interviews and risk perceptions (**a**) and between the evidence-based session and the baseline interviews (**b**). Different *superscripts* indicate different means at $p<.10$

contrasts. As depicted on the left of the charts in Fig. 4, lower risk perception youth who received the evidence-based session *alone* reported higher condom use (F (1, 301)=5.11, $p<.05$) and more 100 % protected sex with secondary partners (OR (1, 5)=2.67, $p<.05$) than the standard of care youth. In turn, youth with lower risk perceptions in the rest of the conditions did not report enhanced safer sex relative to youth in the standard of care group. Both interviews had similar effects on behavior and on the efficacy of the evidence-based session at reducing risk behavior.

Next, we compared the posttest condom use of youth with higher risk perceptions in the standard of care group with that of those in the rest of the higher risk perception conditions. The comparisons are depicted on the right of the charts in Fig. 4. Compared with higher risk perception youth in the standard of care group, higher risk perception youth who received the interviews, the evidence-based session, or both, *all* reported *higher condom use with primary partners* (frequency-based F (1, 381)=8.78, $p<.01$; event-based F (1, 381)=4.15, $p<.05$; evidence-based session F (1, 381)=25.24, $p<.001$; frequency-based interview/evidence-based session F (1, 381)=10.38, $p<.001$, event-based interview/evidence-based session F (1, 380)=5.28, $p<.05$); *higher condom use with secondary partners* (frequency-based F (1, 327)=8.60, $p<.01$, event-based F (1, 327)=11.57, $p<.001$; evidence-based session F (1, 327)=12.48, $p<.001$; frequency-based interview/evidence-based session F (1, 327)=11.04, $p<.01$, event-based interview/evidence-based session F (1, 327)=11.03, $p<.01$), and *higher rates of 100% protected sex with secondary partners* (frequency-based OR (1, 5)=2.32, $p<.05$; event-based OR (1, 5)=2.47, $p<.01$; evidence-based session OR (1, 5)=3.57, $p<.01$; frequency-based/evidence-based session OR (1, 5)=2.60, $p<.05$, event-based/evidence-based session OR (1, 5)=2.74, $p<.05$). Raw differences with the standard of care group ranged from 12 to 19 % for groups that received only interviews, and from 22 to 32 % for those that included the evidence based-session (see Fig. 4). The effects of the interviews replicated regardless of whether they were frequency- or event-based.

Discussion

Whereas there is consensus that behavioral measures can influence behavior and intervention efficacy, this is the first RCT that addresses assessment reactivity in HIV prevention. In a geographic area with high HIV prevalence, we identified the effects of behavioral interviews commonly used in HIV

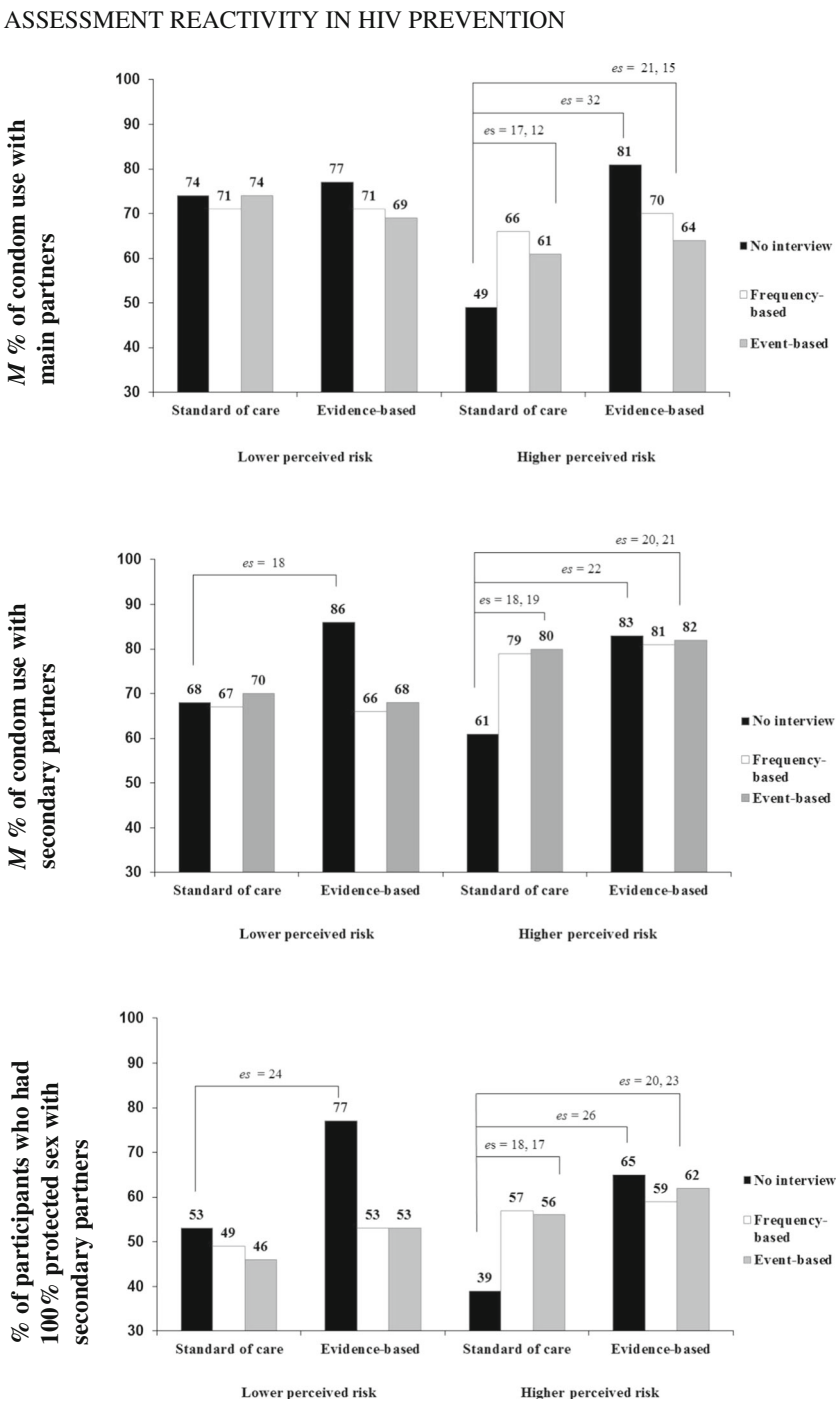

Fig. 4 Condom use in each experimental condition for participants with higher and lower risk perceptions. *Es* above brackets are significant raw differences between an experimental condition and the standard of care group within participants with higher and lower risk perceptions. *N* for condom use with main partners is 929; *N* for condom use with secondary partners and 100 % protected sex with secondary partners is 640

prevention RCTs on risk behavior and the efficacy of an HIV risk-reduction counseling session. Overall, our study indicated that a brief risk-reduction session can be effective without behavioral assessments that could eventually enhance motivation to reduce risk behavior. However, our results also suggested that assessments may not impact behavior and the efficacy of an evidence-based session at reducing HIV risk equally among all respondents. We next discuss these differences in light of the proposed hypotheses.

Effects of the interviews on sexual risk behavior As stated in hypothesis 2a, completing a frequency-based interview increased condom use among youth with higher but not lower risk perceptions. We did not find support for the prediction that completing a detailed event-based interview would reduce risk regardless of respondents' risk perception reports (hypothesis 1a); completing either interview improved reported safer behavior for youth with higher risk estimates, and completing neither interview improved it for those with lower

risk estimates. Moreover, among lower risk perception youth, completing either interview appeared to hinder condom use with occasional partners.

Effect of the interviews on the efficacy of the evidence-based session at reducing sexual risk behavior Unlike the predictions that completing an event-based interview would increase the evidence-based session efficacy at reducing HIV risk among all (hypothesis 1b) and completing the frequency-based interview would do so only among higher risk perception youth (hypothesis 2b) completion of neither interview enhanced the efficacy of the evidence-based session at reducing HIV risk. In fact, the evidence-based session tended to be less effective at reducing risk behavior when combined with either behavioral interview, most markedly for lower risk perception youth. Notably, the interviews, the evidence-based session, or the two together did not increase condom use with main partners among lower risk perception youth, which may speak to the difficulty of increasing perceptions that sex with stable partners may be still risky.

Our findings suggest that completing behavioral interviews may either reinforce or change sexual risk behaviors depending on whether respondents are aware of their risk for HIV at the time of the interview. Our exploratory analyses suggested that when participants felt at risk for HIV, completing the interviews increased reported safer behavior relative to the standard of care group. However, when youth thought that they were at lower risk, they tended to report less safe behavior following the interviews and to be unresponsive to the evidence-based session implemented after the interviews. This pattern is consistent with the hypothesis that behavioral assessments may highlight the positive affective implications of risky sex and increase resistance to change, unless other motivations are salient at the time of the assessment. Whereas we did not find that the event-based interview enhanced behavior change among all youth, higher risk perceptions at the time of either interview may have highlighted the negative aspects of the risk behaviors, motivating youth to avoid further risk. In this light, the reasons why the evidence-based session was less effective with the interviews among higher risk perception youth are unclear. Still the fact that the effect was observed particularly among lower risk perception youth and with condom use with stable partners suggests that respondents' motivations may still play a role. Further research with detailed measures of cognitive processing can fully determine if our findings reflect these processes.

Implications of results for HIV prevention RCTs In line with studies on substance use, [6, 33, 35, 40] our findings indicate that the efficacy of the behavioral HIV prevention strategies may be underestimated. According to our results, assessments may not only improve safer behavior in control groups but also offset the effect of effective interventions in less motivated individuals. If this were replicated, researchers may need to reexamine results from RCTs so that development of much needed brief risk reduction strategies is not haltered by deceptively low effect sizes or misleadingly null findings, particularly among groups not yet sensitive to the risk for HIV.

Implications of results for clinical settings Our results suggest that simple frequency-based interviews of risk behavior can be used as low cost risk-reduction interventions in busy clinical settings that provide services to communities at highest risk for HIV. Among youth with higher risk perceptions, the frequency-based interview increased reported safer sex by an average of 37 %, which is lower than the effect of the evidence-based session but comparable with that of more complex interventions [44]. Thus, youth with lower risk perceptions and multiple or secondary partners may benefit from an intensive counseling session. However, youth with higher risk perceptions who have multiple or secondary partners can reduce risk following a less costly frequency-based behavioral interview, which requires minimal staff training and time.

Strengths and Limitations

Our findings cannot be fully accounted for by a ceiling effect, fatigue, or regression to the mean. Ceiling effects cannot explain increases in safer sex following counseling among lower risk perception respondents. Regression to the mean cannot explain differences within higher and lower perception groups. Fatigue was plausible during interviews and sessions. However, youth with higher risk perceptions experienced changes following the evidence-based session with or without the event-based assessment, which required more effort.

Several limitations should be noted in the study. We based our conclusions on self-reported behaviors, which are biased and can cause further reactivity. Given the need to reduce reactivity to measures other than behavior, we did not include measures of potential mediators of the observed effects. Because measures may make risk perceptions cognitively accessible, results could have differed if these were omitted. Results are applicable to the population in question; the conditions in South African townships are unlikely to replicate in lower HIV prevalence contexts. Youth are less likely to control their affect than adults; risk behavior reports may have different effects across ages. Lastly, we disaggregated conditions to enhance understanding of experimental patterns, given the multiple interactions. Despite limitations, this is the first experimental analysis of assessment reactivity in HIV prevention. Our results were markedly consistent across interviews and can inform further examination of the discussed processes.

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Conflict of Interest and Adherence to Ethical Standards Laura R. Glasman, Donald Skinner, Laura M. Bogart, Seth C. Kalichman, Timothy McAuliffe, Cheryl A. Sitzler, Yoesrie Toefy, and Lance S. Weinhardt declare that they have no conflict of interest. All procedures, including the informed consent process, were conducted in accordance with the ethical standards of the institutional review boards of the Medical College of Wisconsin, Stellenbosch University, and the City of Cape Town Health Department and with the Helsinki Declaration of 1975, as revised in 2000.

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