HIV Prevention Interventions to Reduce Racial Disparities in the United States: A Systematic Review

Vagish Hemmige, MD[1], Rachel McFadden, BS[1], Scott Cook, PhD[2], Hui Tang, MS[2], and John A. Schneider, MD MPH[1,3]

[1]Department of Medicine, University of Chicago, Chicago, IL, USA; [2]The Center for Health and the Social Sciences, University of Chicago, Chicago, IL, USA; [3]Department of Health Studies, University of Chicago, Chicago, IL, USA.

Racial and ethnic minorities are disproportionately affected by HIV/AIDS in the United States despite advances in prevention methodologies. The goal of this study was to systematically review the past 30 years of HIV prevention interventions addressing racial disparities. We conducted electronic searches of Medline, PsycINFO, CINAHL, and Cochrane Review of Clinical Trials databases, supplemented by manual searches and expert review. Studies published before June 5, 2011 were eligible. Prevention interventions that included over 50 % racial/ethnic minority participants or sub-analysis by race/ethnicity, measured condom use only or condom use plus incident sexually transmitted infections or HIV as outcomes, and were affiliated with a health clinic were included in the review. We stratified the included articles by target population and intervention modality. Reviewers independently and systematically extracted all studies using the Downs and Black checklist for quality assessment; authors cross-checked 20 % of extractions. Seventy-six studies were included in the final analysis. The mean DB score was 22.44 – high compared to previously published means. Most of the studies were randomized controlled trials (87 %) and included a majority of African-American participants (83 %). No interventions were designed specifically to reduce disparities in HIV acquisition between populations. Additionally, few interventions targeted men who have sex with men or utilized HIV as a primary outcome. Interventions that combined skills training and cultural or interactive engagement of participants were superior to those depending on didactic messaging. The scope of this review was limited by the exclusion of non-clinic based interventions and intermediate risk endpoints. Interactive, skills-based sessions may be effective in preventing HIV acquisition in racial and ethnic minorities, but further research into interventions tailored to specific sub-populations, such as men who have sex with men, is warranted.

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INTRODUCTION

It has been 30 years since the first cases of HIV infection were reported in the United States.[1] The past three decades of HIV intervention research have attenuated several mechanisms of HIV acquisition. Intravenous drug use has become less relevant in the past decade,[2–4] and mother-to-child prevention programs have substantively reduced mother-to-child transmission rates.[5] Since the mid-1990s new HIV cases have steadily declined among whites, however, sexual transmission persists in racial minority groups fueled by sexual mixing patterns.[6,7] According to a recent Centers for Disease Control and Prevention report, in 2008 the HIV diagnosis rate among blacks was 799 % higher than for whites, and 205 % higher among Latinos than whites.[4] Among women the disparity is even more pronounced, with the rate of diagnosis over 1,830 % higher for blacks and 359 % for Latinas.[4]

Thirty years into the epidemic we find ourselves at a watershed moment, with biomedical interventions such as microbocides and pre-exposure prophylaxis (PrEP) demonstrating promise in moderating the sexual transmission of HIV.[8,9] Yet there is still much we can draw from past studies in designing the future of HIV interventions. For instance, a behavioral intervention that effectively increases condom use among its participants may be adapted to promote the concomitant use of PrEP. Accordingly, as part of a symposium of systematic reviews targeting racial disparities in health care commissioned by the Robert Wood Johnson Foundation, we conducted a systematic review of interventions aimed at reducing the sexual transmission of HIV among racial minorities in the United States. Previous reviews have focused on specific population categories, international settings, intervention modalities, or specific theoretical or conceptual models, or have limited themselves to interventions tested in randomized control

trials.[10–14] This review builds upon previous work by including interventions targeting a range of at-risk minorities as well as those evaluated in non-randomized trials, using a standardized metric to assess the quality of each study. Further, our review differs by limiting to interventions conducted directly within or linked to a clinical setting. This criterion was standardized for all reviews in this symposium, and acknowledges the context in which forthcoming biomedical interventions will likely be implemented. Because few interventions utilized biologic endpoints such as incident HIV, we included studies that employed condom use as an outcome measure. Studies measuring only intermediate behavioral endpoints such as reduction in number of partners were not included, since improvement in these endpoints does not necessarily correlate with HIV or other sexually transmitted infection (STI) incidence.[15,16] Studies that included the treatment of STIs for prevention of HIV were included. The primary objective of this review is to assemble a guide of effective interventions that reduce the sexual acquisition of HIV among racial minorities and may be implemented by health professionals in a clinical setting.

METHODS

Data Sources

The online appendix contains a description of our *Electronic Databases Search*, *Manual Searches, Data Synthesis* and *Quality and Bias Assessment*. The final search was completed on the 30th anniversary of the first reported case of HIV infection, so that articles published before June 5, 2011 were eligible for inclusion.[1] Databases searched included MEDLINE search engine, the Cochrane Review of Clinical Trials, CINAHL, and PsycINFO. A bibliographic review of previous reviews was also conducted to further identify interventions.

Study Selection

The operational definition of intervention used during our search was an explicitly stated intervention designed to decrease the sexual acquisition of HIV within a racial or ethnic minority population in the United States.[17] Inclusion criteria included the following:

1) Population composed of at least 50 % minority adults or adolescents of any ethnic or cultural background, or race/ethnicity sub-analyses.
2) Formal health care association, either through participant recruitment (e.g. sexually transmitted infection clinics, health center outpatients) or location of intervention implementation (e.g. community health center, clinic waiting room).
3) Conducted in the United States
4) Condom use or biological endpoint
5) Publication as a full manuscript or brief report in English

We excluded "prevention for positives" interventions, because these interventions to prevent the onward *transmission* of HIV by seropositive patients differ greatly from those to aiming to prevent HIV *acquisition* by seronegative patients. Studies that focused primarily on curtailing substance use in people at risk for HIV were also excluded; though changing substance use patterns may affect rates of risky sexual behaviors, it was felt that an evaluation of substance use interventions in minority populations was outside the scope of the current review. We did not limit inclusion by study design and no time frame criterion was used.

All included manuscript citations were compiled into a single "library" using citation manager software (EndNote X3, 2009). A single research assistant conducted a first pass through the articles, sorting manuscripts as "include", "exclude" or "uncertain" based on title and abstract. A second pass was conducted by the study authors. Articles marked "uncertain" from both passes were reviewed a third time by the lead and final authors to determine eligibility (Fig. 1). Included manuscripts were then sorted based on target population as described by authors of the *reviewed* studies. These target population categories were STD clinic patients, adolescents, drug users, "high-risk" women or men (i.e., those reporting frequent unprotected sex, concurrent partners, or men who have sex with men), "vulnerable" women (i.e., low-income women), and "other". Within target population, interventions were stratified by delivery method (peer delivery, health worker delivery, or digital delivery).

Quality Assessment

To assess study quality, each study was rated using a scoring algorithm specifically developed for this symposium[18] modified from that proposed by Downs and Black.[19] The original Downs and Black score is calculated by rating each study across a variety of domains including reporting (nine items), external validity (three items), bias (seven items), confounding (six items), and power (one item). We simplified scoring of the power item from a five-point range to a binary system, granting one point (1) for adequate power calculations or no points (0) if power was not adequately addressed. We added one item from the Cochrane tool[20] for bias assessment that was not captured by the DB protocol, for a maximum modified DB score of 29. The average DB score of 213 studies included in the first set of systematic reviews commissioned by the

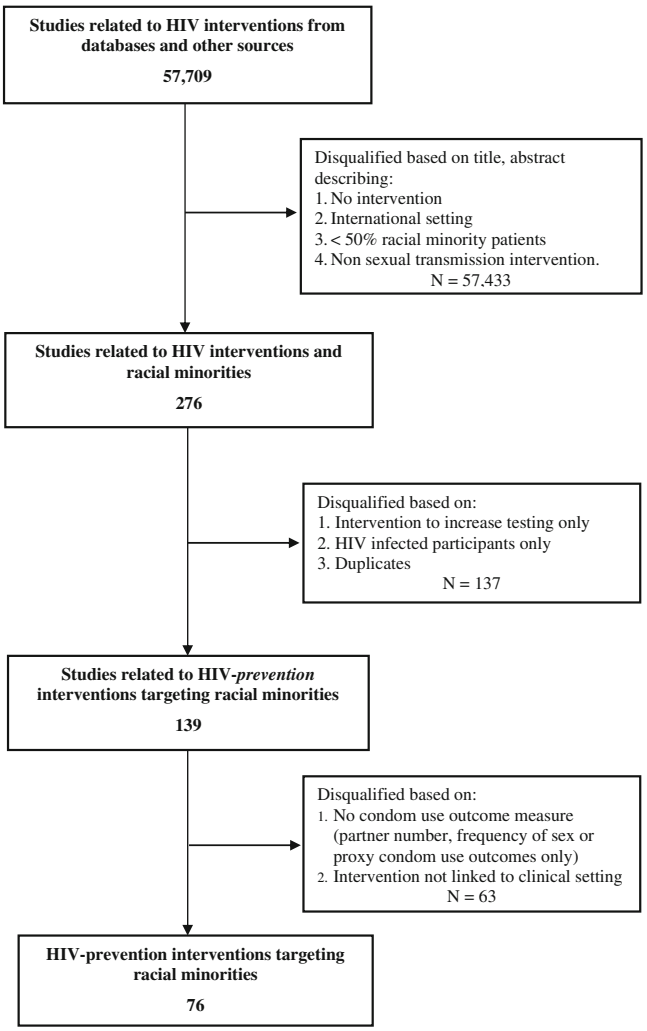

Figure 1. Criteria used for analysing HIV-prevention interventions targeting racial minority population.

Robert Wood Johnson foundation was 17.65 out of a maximum of 27 point (the scoring instrument used in these reviews excluded the power item and Cochrane-derived bias item).[21] Initial ratings for this review were conducted by the first four authors and two trained research assistants, using a Microsoft Access database designed for this symposium to calculate the DB score for each study. As a quality control measure, 20 % of studies were re-scored by the final author, and the inter-rater agreement for quality score using the modified DB tool was adequate (κ=0.67).

The database simultaneously captured further information about the journal of publication, study design, follow-up time, subject demographics, and outcomes. Linear regression was used to examine trends in DB score over time. All analysis was performed using STATA software version 11.0.

RESULTS

Study Design and Quality

No study was identified that sought specifically to reduce racial disparities in the sexual acquisition of HIV. A total of 76 articles published between 1981 and 2011 that describe interventions to prevent the sexual acquisition of HIV in minority populations were identified, and are listed according to target population in Tables 1, 2, 3, 4, 5, 6 and 7. Nearly 87 % (66) of the studies were randomized controlled trials; the remainder included 7 (9 %) pre- and post-observational studies, and a mixture of other observational studies (3; 4 %). According to our modified DB scoring system, the quality of the 76 intervention studies ranged from 15 to 29 with a mean of 22.44. Following a previously published DB rating system,[19] sixty-three (83 %) of the studies were rated as very good (>20), 12 (16 %) as good (16–19), and only 1 (1 %) as fair (11–15); no study was rated poor (≤10). In linear regression analysis, a borderline significant linear trend of increasing quality over time was observed (r=0.11; p=0.075).

Populations and Settings

The majority of studies 61 (80 %) included over 50 % African American participants, with 22 (29 %) of these study groups composed exclusively of African Americas. Eleven studies (14 %) included a majority of Latino/a participants, with 6 (8 %) exclusively Latino/a studies. The remaining 4 (5 %) interventions included some combination of African American, Latino/a, Asian, or other non-white participants resulting in an overall ≥50 % racial minority population. Interventions were located in every region of the United States[22] with 23 (30 %) studies taking place in the South, 17 (22 %) in the Northeast, 14 (18 %) on the West coast, 13 (17 %) in the Midwest, 8 (10 %) across multiple regions, and 1 intervention that did not specify location.

The most common target population was STD clinic patients, with 16 (21 %) interventions among this group. Fifteen (20 %) studies targeted adolescents, 15 (20 %) vulnerable women, 13 (17 %) drug users, 5 (6 %) high-risk women, 2 (3 %) high-risk men, and 10 studies (13 %) targeted other groups.

Intervention Delivery Method

Health worker delivery was the most common delivery method (65 %), followed by digital delivery (21 %) and peer delivery (14 %), although it is important to note that all digital and peer interventions were delivered with some health worker facilitation. Thirty-eight (50 %) interventions included condom use skills training, while the remaining half relied on

Table 1. HIV Prevention Interventions Targeting Adolescents (n=15)

Reference	Design	Target	Location	Intervention	Sample Size	Follow-up (mo.)	Race	BMO*	Results	Score
Digital Delivery										
Boekeloo et al.[55]	RCT	Adolescents	Washington, DC	Single, didactic + interactive, 1-on-1 session	215	3, 9	AA: 65 %, O: 13 %, L: 3 %	-	Sexually active intervention participants with greater condom use at 3 months (OR 18.01; 95 % CI: 1.27, 256.03), and fewer self-reported STI symptoms (0 %) than the control group (7 %) at 9 months (p=0.02).	26
DeLamater et al.[34]	RCT	Adolescents (M)	Milwaukee, WI	1)Single, didactic, 1-on-1 session; 2)1 + skills (health worker delivered)	562	1, 6	AA: 100 %	-	At posttest, 18 % of total participants reported consistent condom use with their steady partners, which increased to 51 % at 6 months. Among those with casual partners, the percentages were 26 % and 50 %, respectively.	20
Downs et al.[56]	RCT	Adolescents (F)	Pittsburg, PA	Single, didactic + interactive, 1-on-1 session	300	1, 3, 6	AA: 75 %, O: 10 %	+	There was no difference in condom use between conditions from baseline to 3 months [F(1,213) =0.33; p=0.57] nor from 3 to 6 months [F(1,213) =2.13; p=0.15). At 6 months, however, intervention participants were less likely have been diagnosed with an STI (OR 2.79; p=0.05).	20
Roye et al.[57]	RCT	Adolescents (F)	New York, NY	1) Single, didactic, 1-on-1 session; 2) Single, interactive, 1-on-1 session (health worker delivered); 3) 1+2	400	3, 12	L: 55 %, AA: 45 %	-	Intervention 3 group reported 2.5 times more condom use at last sex than the control group (χ^2=3.46; p=0.05). No effect was found for incident STI rate.	25
Peer Delivery										
DiClemente et al.[27]	RCT	Adolescents (F)	Birmingham, AL	Multi, didactic + interactive + skills, group sessions	522	6, 12	AA: 100 %	+	The intervention group reported more consistent condom use (AOR 2.30; 95 % CI: 1.51, 3.50; p<0.001) and a lower rate of clymadial infection (OR 0.17; 95 % CI: 0.03, 0.92; p=0.04) than the control group over the 12 month follow up.	29
DiClemente et al.[58]	RCT	Pregnant adolescents (F)	Atlanta, GA	Multi, didactic + interactive + skills, group sessions	311	12	AA: 100 %	-	Intervention participants reported greater condom use at last intercourse (AOR 3.9; 95 % CI: 1.00, 15.71; p=0.05) and consistent condom use (AOR 7.9; 95 % CI: 1.00, 56.7; p=0.05) at follow up.	28

Table 1. (continued)

Reference	Design	Target	Location	Intervention	Sample Size	Follow-up (mo.)	Race	BMO*	Results	Score
Prado et al.[59]	RCT	Adolescents	Miami, FL	Parent delivered (training by health workers); Multi, interactive, group sessions	266	6, 12, 24, 36	L: 100 %	-	The intervention group reported more condom use at last intercourse (19.2 %) than the control group (44.4 %; χ^2=3.87; p<0.05).	22
Health Worker Delivery										
DiClemente et al.[28]	RCT	Adolescents (F)	Atlanta, GA	Multi, didactic + interactive, group sessions	715	6, 12	AA: 100 %	+	The intervention group had a lower rate of chlamydial infection (RR 0.65; 95 % CI: 0.42, 0.98; p=0.04) and a higher proportion of condom use at 12 month follow up (mean difference 10.84; 95 % CI: 5.27, 16.42; p=0.001)	25
Jemmott et al.[60]	RCT	Adolescents (M)	Philadelphia, PA	Single, didactic + interactive, group sessions	157	3	AA: 100 %	-	Risk data reported in aggregate (i.e. multiple partners, condom use, anal intercourse). Intervention group risk score was lower than control group at 3 months (F=6.48; p<0.01).	20
Jemmott et al.[61]	RCT	Adolescents (F)	Philadelphia, PA	1)Single, didactic + interactive + Skills, group session; 2) 1 + no skills training	682	3,6, 12	AA: 68 %, L: 32 %	+	Over 12 months, the Intervention 1 group reported fewer unprotected sex acts (mean 2.27; SE 0.81) than Intervention 2 (4.04, SE 0.80; p=0.03) or control group (5.05; SE 0.81; p=0.002), and had a lower incident STI rate (mean 10.5 %; SE 2.9 %) than the controls (18.2 %; SE 2.8 %; p=0.05).	27
Jemmott et al.[62]	RCT	Adolescents	Philadelphia, PA	Multi, didactic + interactive, group sessions	1707	3, 6, 12	AA: 90 %	-	Intervention group with more consistent condom use (OR 1.39; 95 % CI: 1.06, 1.85) and higher proportion of protected sex (β=0.06; 95 % CI: 0.00, 0.12) at 12 months.	27
Lesser et al.[63]	RCT	Adolescent parents	Los Angeles, CA	Multi, didactic + interactive + skills, group sessions	336	3, 6	L: 78 % male, 86 % female	-	Less unprotected sex was reported by females (effect estimate -0.192; SE 0.056; p=0.002) and males (effect estimate -0.082; SE 0.037; p=0.031) of the intervention group over 6 months.	23
Orr et al.[64]	RCT	Adolescents (F)	Indianapolis, IN	Single, interactive, 1-on-1 session	219	½, 6	AA: 55 %	+	The intervention group reported higher condom during vaginal intercourse (OR 3.1; 95 % CI: 1.4, 6.8; p=0.005) than the control group, however no significant difference was found in incident STI rate (26 % vs. 17 %; p=0.30)	21
Rotheram-Borus et al.[65]	RCT	Adolescents	New York, NY	Multi, didactic + interactive + skills, group + 1-on-1 sessions	311	3, 6, 12, 18, 24	AA: 59 %, L: 26 %	-	Intervention females reported lower unprotected sex than control females at 24 months (OR 0.35; p=0.018). No significant change was found among males.	24

Table 1. (continued)

Reference	Design	Target	Location	Intervention	Sample Size	Follow-up (mo.)	Race	BMO*	Results	Score
St Lawrence et al.[26]	RCT	Adolescents	Jackson, MS	Multi, didactic + interactive + skills, group sessions	246	6, 12	AA: 100 %	-	Both conditions saw a decline in condom use over the 12 month follow up, although the proportion of protected sex acts was higher in the intervention group compared to the control groups at all follow up points [$F(1,134)=5.94$; $p<0.05$].	24

RCT—Randomized controlled trial; Pre/Post—Pre-test/Post-test; F—Female; M—Male; AA—African American; L—Latino/a; O—other ethnicity/race; BMO—Biomarker outcome
**In addition to condom use; Biomarkers include incident sexually transmitted infection, and incident HIV where indicated*

didactic or interactive content, or a combination of these two. Finally, 22 (29 %) studies consisted of a single intervention session, while the majority (51; 67 %) included multiple sessions, and two studies compared single versus multiple session interventions. Two (3 %) interventions did not involve sessions, and instead employed social marketing[23] or social network-based strategies[24] to disseminate prevention messages.

Outcome Measures

Each intervention evaluated condom use as an outcome as a result of our inclusion criteria; nineteen (25 %) studies additionally measured incident STIs, including 6 (9 %) that specifically sought incident HIV (though sero-incidence was generally too low to draw meaningful conclusions). For the 6 studies with HIV sero-incidence as an outcome, the overall rate of new infection was 0.1 % (95 % CI [0.0 %, 0.4 %]) in the intervention groups.

Target Populations

Tables 1, 2, 3, 4, 5, 6 and 7 summarize the results for each target populations as defined by the study authors. Salient findings from studies that target populations currently at greatest risk for HIV in the United States are reviewed in detail below.

Adolescents

A number of interventions for adolescents have been developed and tested in recent years. An important feature of successful interventions targeting this demographic of individuals who are near the age of sexual debut is the presence of skills-based instruction on both appropriate condom use and effective ways of negotiating condom use with a partner. As early as 1992, Jemmott and others describe an intervention for African American male adolescents that led to a decrease in number of sexual partners and increased condom use after 3 months of follow-up, compared to a control group. The intervention was specifically designed for this population, and served to both educate adolescents about HIV/AIDS and teach condom usage and safe-sex negotiation.[25] In another intervention trial for adolescents, skills-based training resulted in a greater proportion of initially abstinent adolescents who remained abstinent after one year of follow-up, compared with an information-only intervention that lacked skills-based instruction.[26]

An intervention that includes these essential elements and is successfully tested in an adolescent population may be adapted for a variety of aims, as long as the core elements

Table 2. HIV Prevention Interventions Targeting Drug Users (n=13)

Reference	Design	Target	Location	Intervention	Sample Size	Follow-up (mo.)	Race	BMO*	Results	Score
Peer Delivery										
Gollub et al.[66]	RCT	Drug users (F)	New York, NY; Philadelphia, PA; Providence, RI	Multi, interactive, group sessions.	189	2	AA: 68 %, O: 8 %	-	Intervention group with increase in mean monthly condom use (mean increase 1.13 uses/month for male condoms and 0.77 uses/month for female condoms; $p<0.001$).	17
Cottler et al.[67]	RCT	Out-of-treatment drug users	St. Louis, MO	Multi, didactic + interactive, group sessions	725	3,6,9,12	AA: 93 %	-	Both cohorts demonstrated a decrease in condom use over time; no significant difference between groups (43 % of intervention cohort with improved condom use vs. 44 % of control).	22
Health Worker Delivery										
Avins et al.[68]	Pre/Post	Alcohol dependents	San Francisco, CA	Standard HIV education at alcohol abuse treatment centers	700	13	AA: 50 %, L: 13 %, O: 5 %	-	Participants increased consistent condom use with multiple partners (RR 1.77; $p<0.01$).	20
Deren et al.[69]	RCT	Injection drug users and their sex partners	Harlem, NY	1) Single, didactic, group session; 2) Multi, didactic + skills, group sessions 3) No intervention	1770	6	AA: 100 %	+	All three interventions yielded an increase in condom [RR 2.1, 2.5, and 1.8, respectively, comparing pre- to post-intervention condom use of IDUs with main partners; 1.5, 1.6, and 1.4 with multiple partners; 1.5, 2.0, and 1.4 for their sexual partners with multiple partners; $p<0.001$)] No difference between intervention groups, or between drug users and sex partners.	16
Gibson et al.[70]	RCT	Heroin detoxify-cation clients	San Francisco, CA	1) Single, interactive + skills, 1-on-1 session; 2) 1+VCT	404	1) 3, 12; 2) 6, 12	AA: 32 %, L: 20 %	-	No significant difference in proportion reporting 100 % condom use at 12 months between intervention and control groups in either Intervention 1 (pre/post RR 1.8 vs. 1.) or 2 (RR 2.4 vs. 0.9).	26
Harris et al.[71]	RCT	Methadone-maintained drug users (F)	Baltimore, MD	Multi, didactic, group sessions.	204	2, 4, 7	AA: 100 %	-	Intervention group with greater increase in condom use [$F(1,127)=4.87$; $p=0.029$] over 7 months.	25
Koblin et al.[72]	RCT	Non-injection drug users (F)	New York, NY	Multi, didactic + interactive + skills, group sessions.	311	1, 6, 12	AA: 66 %, L: 24 %, O: 10 %	-	All participants with increased condom use at 6 and 12 months for both groups (exact numbers not provided; $p<0.001$); no significant difference between groups.	24
Kotranski et al.[73]	RCT	Out-of-treatment drug users	Philadelphia, PA	Multi, didactic + interactive, group + 1-on-1 sessions	684	6	AA: 85 %	-	Control group with greater reduction in unprotected vaginal sex (75 % to 42 % in control vs. 75 % to 52 % in intervention; pre/post RR 0.6 for control and RR 0.7 for intervention; $p=0.05$).	24
Latkin et al.[74]	RCT	Drug users	Baltimore, MD	Multi, interactive + skills, group sessions	250	6	AA: 94 %	-	Intervention group more likely to report increase in condom use with casual partners (18 % vs. 5 %; $p<0.05$).	25

Table 2. (continued)

Reference	Design	Target	Location	Intervention	Sample Size	Follow-up (mo.)	Race	BMO*	Results	Score
Malow et al.[75]	RCT	Drug users (M)	New Orleans, LA	Multi, interactive + skills, group sessions	152	3	AA: 100 %	-	Both cohorts reduced high-risk behavior (defined as >1 sex partner AND less than 100 % condom use) at 3 months (75 % to 32 % in intervention and 75 % to 48 % in controls; χ^2=25.35; p<0.001). No significant difference between groups.	20
Malow et al.[76]	RCT	Non-injection drug users (F)	Miami, FL	Multi, interactive + skills, group sessions	41	3	AA: 69 %, L: 14 %	-	Risk data reported in aggregate. HIV-negative intervention group members with increase in mean proportion of condom *or* microbicide use (0.14 to 0.35; sign test, N=12, x=0 p<0.001); no significant difference between groups (Kruskal-Wallis one-way analysis of variance, H=1.32).	21
Robles et al.†[77]	Pre/Post	Drug users	Multicity	Multi, interactive + skills, groups sessions	981	6, 9	AA: 86 %	-	HIV positive participants reduced frequency of unprotected vaginal sex at follow-up compared with HIV negative individuals (OR 0.2; $p\leq$0.05)	20
Schilling et al.[78]	RCT	Drug users (F)	Bronx, NY	Multi, interactive + skills, group sessions	91	3	L: 64 %, AA: 36 %	-	Intervention group with higher frequency of condom use (2.6 vs. 1.8; p=0.001).	24

RCT—Randomized controlled trial; Pre/Post—Pre-test/Post-test; F—Female; M—Male; AA—African American; L—Latino/a; O—other ethnicity/race; BMO—Biomarker outcome
**In addition to condom use; Biomarkers include incident sexually transmitted infection, and incident HIV where indicated*
†Results from AA subsample

Table 3. HIV Prevention Interventions Targeting STD Clinic Patients (n=16)

Reference	Design	Target	Region	Intervention	Sample Size	Follow-up (mo.)	Race	BMO*	Results	Score
Digital Delivery										
Artz et al.[79]	Pre/Post	STD clinic patients (F)	Birmingham, AL	Single, didactic + skills, 1-on-1 session	1159	6	AA: 84 %	-	The increase in condom use was significant for women who reported sexual activity in the 30 days before and after intervention (N=702; χ^2=254.9; p<0.001).	22
Grimley and Hook[42]	RCT	STD clinic patients	Birmingham, AL	Single, interactive, 1-on-1 session	430	6	AA: 89 %, O: 2 %	+	Intervention group more likely to report using condoms 100 % of the time compared to control group (32 % vs. 23 %; X^2=2.34, p= 0.03), and with lower STI incidence (OR 1.91; 95 % CI; 1.09, 3.34; p=0.04) at 6 months.	25
Kalichman and Cherry[80]	RCT	STD clinic patients (M)	Georgia	Single, didactic + skills, group session promoting 1) male latex condoms; 2) male polyurethane condoms	106	1,3	AA: 100 %	-	Higher condom use in intervention group compared to control group at 1 month (F=5.6; p<0.01), but no significant difference between conditions at 3 or 6 months.	26
Kalichman et al.[41]	RCT	STD clinic patients	Atlanta, GA	Multi, didactic + interactive + skills, groups sessions	117	3, 6	AA: 100 %	-	The intervention group had higher condom use rates [F(l, 66)=5.38, p<0.05, d=0.55] relative to the controls at 3 months. No differences between conditions were seen at 6 months.	22
Warner et al.[39]	RCT	STD clinic patients	Denver, CO; Long Beach, CA; San Francisco, CA	Single, didactic, group session	8635	14.8 (mean)	L: 25 %, AA: 18 %, O: 11 %	+†	Intervention group with lower rate of incident STI (HR 0.91; 95 % CI: 0.84, 0.99).	23
Wenger et al.[81]	RCT	STD clinic patients	(Los Angeles, CA)	Single, didactic + interactive, 1-on-1 session	186	2	AA: 87 %	-	Greater increase in condom use with last partner in intervention (10 % to 27 %) than control group (11 % to 13 %; p=0.05)	24
Peer Delivery										
Crosby et al.[82]	RCT	STD clinic patients (M)	Kentucky	Single, interactive + skills, 1-on-1 session	266	3, 6	AA: 100 %	+	Intervention group with higher rate of condom use at last sexual encounter (AOR estimate 0.32; 95 % CI: 0.12, 0.86; p=0.02) and fewer incident STIs at 6 months (AOR estimate 2.20; 95 % CI: 1.08, 4.48; p=0.03)	26
Health Worker Delivery										
Boyer et al.[83]	RCT	STD clinic patients	San Francisco, CA	Multi, didactic + interactive, 1-on-1 sessions	399	3, 5	L: 42 %, AA: 38 %,	+	The intervention group showed a greater decrease in unprotected sex than the control group (χ^2=4.43, p<0.05) at 3 months. There was no difference between groups in STI incidence by men (χ^2=0.28; p>0.20) or women (χ^2=0.74, p>0.20) at 6 months.	23
Branson et al.[84]	RCT	STD clinic patients	Houston, TX	Multi, didactic + interactive + skills, group sessions	964	2, 6, 9, 12	AA: 90 %, O: 4 %	+†	No significant difference in STI incidence was found between the control (27 %) and intervention (26 %) groups (p>0.15).	24
Carey et al.[85]	RCT	STD clinic patients	Upstate New York	1) Multi, didactic + interactive, 1-on-1 + group sessions; 2) 1+ skills; 3) Multi, interactive, 1-on-1 + groups; 4) 3 + skills	1483	3, 6, 12	AA: 64 %; O: 12 %	+†	A decrease in unprotected sex acts and incident STIs were not sustained over the full 12 months, and no differences were found between intervention conditions. However at 3 months, unprotected sex events decreased from 17.2 to 11.8 (p<0.0001), and the odds of an STI also decreased (OR 0.87; 95 % CI: 0.79, 0.95; p<0.001).	23

Table 3. (continued)

Reference	Design	Target	Region	Intervention	Sample Size	Follow-up (mo.)	Race	BMO*	Results	Score
Kalichman et al.[86]	RCT	STD clinic patients (F)	Atlanta, GA	Single, didactic + interactive + skills, group sessions	105	1, 3	AA: 100 %	-	The intervention group was less likely to request female and male condoms than the control group (26 % vs. 1 %; 8 % vs. 19 % respectively; $p<0.01$).	22
Kamb et al.[37]	RCT	STD clinic patients	Baltimore, MD; Denver, CO; Long Beach, CA; Newark, NJ; San Francisco, CA	1) Multi, didactic + interactive, 1-on-1 sessions; 2) Multi, enhanced VCT, 1-on-1 sessions	5758	3, 6, 8, 12	AA: 59 %, L: 19 %, O: 6 %	+†	The incident STI rate was 14.6 % in the control group, compared to 11.5 % among Intervention 1 (RR 0.78; 95 % CI: 0.64, 0.94) and 12.0 % among Intervention 2 (RR 0.81; 95 % CI: 0.67, 0.98) participants. 0 incident HIV in Intervention 2, compared to 4 incident HIV in Intervention group 1, and 4 in control ($p=0.06$).	25
Metcalf et al.[87]	RCT	STD clinic patients	Denver, CO; Long Beach, CA; Newark, NJ	Single-visit VCT (Rapid test intervention group; 2-visit VCT control group)	3297	3, 6, 9, 12	AA: 51 %, L: 18 %	+†	Rates of unprotected sex were similar between groups at 3 months (control 62.5 %; intervention 64.2 %, RR 1.03; 95 % CI: 0.97, 1.09). Men in the intervention group had a significantly higher incidence of STIs than those in the standard-test group over 12 months (RR 1.34; 95 % CI: 1.06, 1.70; $P<0.02$).	22
Metcalf et al.[88]	RCT	STD clinic patients	Denver, CO; Long Beach, CA; Newark, NJ	VCT + Single, interactive, 1-on-1 booster session	3297	3, 6, 9, 12	AA: 51 %, L: 18 %	+	Incident STIs were detected in 8.8 % of the control group and 8.5 % of the intervention group at 12 months (RR 0.97; 95 % CI: 0.78, 1.22).	21
O'Leary et al.[89]	RCT	STD clinic patients	Maryland, Georgia, New Jersey	Multi, didactic + interactive, group sessions	659	3	AA: 91 %, L: 3 %	-	Condom use increased in the control and intervention groups, with no difference in the proportion of condom use at 3 months (50 % for both groups).	18
Shain et al.[90]	RCT	STD clinic patients (F)	San Antonio, TX	Multi, didactic + interactive, group sessions	549	6, 12	L: 69 %, AA: 31 %	+†	The frequency of unprotected sex at 12 months was 79.8 % in the control and 70.3 % in the intervention group ($p=0.03$). The incident STI rate through 12 months was 26.9 % in the control and 16.8 % in intervention group (RR 0.52; 95 % CI: 0.34, 0.81).	21

RCT—Randomized controlled trial; Pre/Post—Pre-test/Post-test; F—Female; M—Male; AA—African American; L—Latino/a; O—other ethnicity/race; BMO—Biomarker outcome
**In addition to condom use; Biomarkers include incident sexually transmitted infection, and incident HIV where indicated*
†Indicates incident HIV infection outcome
‡However all were positive at first test after baseline, and therefore could have been infected at enrollment

Table 4. HIV Prevention Interventions Targeting High-risk Men (n=2)

Reference	Design	Target	Region	Intervention	Sample Size	Follow-up (mo.)	Race	BMO*	Results	Score
Peer Delivered										
Somerville et al.[24]	Pre/Post	MSM	Vista, CA	MSM trained to disseminate HIV/STI prevention messages among their peers	766 surveyed	24	L: 100 %	-	Surveyed MSM reported higher frequency of condom protected receptive anal sex at year 2 (33.8 % pre-intervention and 50.3 % post-intervention; $p<0.01$).	19
Health Worker Delivered										
Operario et al.[44]	Pre/Post	MSMW	Oakland, CA	Multi, interactive + skills, 1-on-1 sessions	68	3	AA: 100 %	-	Increased condom use during receptive (44 % vs. 22 %; p= 0.04) and insertive (58 % vs. 33 %; $p=0.02$) anal sex with male partners.	18

RCT—Randomized controlled trial; Pre/Post—Pre-test/Post-test; F—Female; M—Male; AA—African American; L—Latino/a; O—other ethnicity/race; BMO—Biomarker outcome; MSM—Men who have sex with men; MSMW—Men who have sex with men and women
**In addition to condom use; Biomarkers include incident sexually transmitted infection, and incident HIV where indicated*

of skill-based content and appropriate cultural targeting remain. For example, a landmark multi-session intervention for sexually active African American adolescents was developed which led not only to an increase in the proportion of adolescents reporting consistent condom use and a decrease in the proportion of adolescents reporting a recent new sexual partner at 1-year follow-up, but also to a decrease in the proportion of adolescents with chlamydial infection after 1 year, when compared to controls.[27] This intervention was implemented by both African American health professionals and peer educators, and involved discussions about African American womanhood in addition to condom use and social skills instruction. Using the same core framework, this intervention was successfully expanded to include STI treatment vouchers for male sexual partners, telephone reminders to reinforce safe sex behaviors in female African American adolescents,[28] and offered to pregnant African American adolescents attending prenatal clinics.[29]

Several studies examined the unique effects of interventions among Latino adolescents, and while the importance of skills training in this subpopulation has been confirmed, the importance of culturally-specific instruction appears to vary. Among participants with overall low rates of sexual activity, an intervention targeting Latino adolescent children and their parents that included material related to mediating the divide between Hispanic and American culture in addition to HIV-specific prevention material led to a significantly lower proportion of adolescents reporting unsafe sex at last intercourse when compared with control interventions which did not include culturally specific material.[30] Additionally, a couples-based intervention drawing on culturally specific values and featuring skills-based training reduced the proportion of unprotected sex acts for Latino adolescent mothers and their sexual partners at 6 months of follow-up, compared to control group couples who received didactic messaging devoid of skills training or a cultural component.[31] However, a skills-based intervention implemented by African American educators in a mixed cohort with both African American and Latino adolescents was more successful than the didactic control, with no significant difference in impact on STI rates or sexual risk behavior between the two racial groups.[32]

Several studies have attempted to adopt the above insights using digital or other media to develop economical interventions for adolescents with mixed results. One intervention for primarily African American young adolescents was implemented in the offices of private practice pediatricians. While waiting to see the physician, adolescents listened to an audiotape that encouraged discussion about safe sex with their pediatricians. Condom use rates improved at 3 months, though no significant effect was observed after 9 months of follow-up.[33] A culturally appropriate video intervention for African American adolescent males in STD clinics demonstrated no improvement in the proportion of adolescents reporting consistent condom use, compared with individual counseling from a health educator or routine STD clinic care.[34] However, a 30-minute interactive video intervention for sexually active adolescent females recruited from several health care settings, when compared to control paper-based educational materials, was associated with an increase in condom use and a 50 % decrease in the proportion of adolescents reporting chlamydia diagnosis after 6 months.[35]

Table 5. HIV Prevention Interventions Targeting High-risk Women (n=5)

Reference	Design	Target	Region	Intervention	Sample Size	Follow-up (mo.)	Race	BMO*	Results	Score
Peer Delivered										
Greenberg et al.[91]	RCT	High-risk (F)	Baltimore, MD; New York, NY; Seattle, WA	Multi, didactic + interactive + skills, group + optional 1-on-1 sessions	510	3, 6	AA: 59 %, L: 14 %	-	An increase in condom protected sex from 3 to 6 months was seen in the control (log OR 0.13; SE=0.18 and 0.25; SE=0.19 respectively), and intervention (log OR=0.30 and 0.33, respectively) groups.	22
Health Worker Delivered										
Carey et al.[92]	RCT	High-risk (F)	Syracuse, NY	Multi, interactive + optional skills, group sessions	102	1, 3	AA: 88 %, O: 6 %	-	An increase in condom protected vaginal sex from pretest to 3 months was seen in the control (0.13; 95 % CI: -0.48, 0.75) and intervention (0.43; 95 % CI: -0.12, 0.97) groups. No difference was found between groups [t(63.4)=1.43, p=0.16].	23
Davey-Rothwell et al.[93]	RCT	High-risk (F)	Baltimore, MD	Multi, interactive, group + 1-on-1 sessions	169	6, 12, 18	AA: 98 %	-	The intervention group showed an increase in condom use during vaginal (AOR 0.47; 95 % CI: 0.25, 0.87) and anal sex (0.24; 95 % CI: 0.09, 0.68), as well as with main (0.41; 95 % CI: 0.21, 0.77) and non-main partners (0.33; 95 % CI: 0.14, 0.79).	18
Raj et al.[47]	RCT	High-risk (F)	Boston, MA	1) Multi, HIV intensive didactic + interactive, group sessions; 2) 1 + skills, less HIV intensive	162	3	L: 100 %	-	At follow up, the magnitude of the increase in condom use in Intervention 1 decreased (AOR 2.92; 95 % CI: 0.86, 9.89) while increasing slightly in Intervention 2 (AOR 5.91; 95 % CI: 1.98, 17.6).	19
Van Devanter et al.[94]	RCT	High-risk (F)	New York, NY; Baltimore, MD, Seattle, WA	Multi, didactic + skills, group sessions	604	3	AA: 58 %, L: 18 %, O: 8 %	-	In a logistic regression, the strongest predictor of condom use was exposure to the intervention (OR 5.5; 95 % CI: 2.8, 10.7)	25

RCT—Randomized controlled trial; Pre/Post—Pre-test/Post-test; F—Female; M—Male; AA—African American; L—Latino/a; O—other ethnicity/race; BMO—Biomarker outcome
**In addition to condom use; Biomarkers include incident sexually transmitted infection, and incident HIV where indicated*

Table 6. HIV Prevention Interventions Targeting Vulnerable Women (n=15)

Reference	Design	Target	Region	Intervention	Sample Size	Follow-up (mo.)	Race	BMO*	Results	Score
Digitally Delivered										
Flaskerud and Nyamathi[95]	Pre/Po-st	Low-income (F)	Los Angeles, CA	Single, didactic, 1-on-1 session	712	2-3	AA: 51 %, L: 49 %	-	Risk data provided in aggregate. Significant differences in risky sex and drug use were found in both the experimental and control groups [F (1,708)=8.27, P=.004].	22
Hobfoll et al.[96]	RCT	Low-income (F)	Akron, Ohio	Multi, didactic + interactive, group sessions	935	6	AA:55 %, O: 3 %	+	The intervention group reported a greater reduction in unprotected sex (from 2.59 to 2.31) than the control group (from 2.64 to 2.48) during at follow up [F(1, 679)=17.00; p<0.001; η^2=0.02]. No significant effect was found for incident STI rate.	20
Kalichman et al.[97]	RCT	Low-income (F)	Chicago, IL	Single, didactic, group session; 1) Gender/Race matched video presenter + standard public health message;2) 1 + culturally tailored content	106	2 weeks	AA: 100 %	-	No significant differences in condom use by intervention condition over time was found.	24
Robinson et al.[98]	RCT	Low-income (F)	Minneapolis, MN	Multi, didactic + interactive, group sessions	218	9	AA: 80 %, L: 13 %, O: 4 %	-	No significant differences in condom use by intervention condition over time was found.	26
Peer Delivered										
Dancy and Berbaum[99]	Pre/Post	Low-income (F)	Chicago, IL	Multi, didactic + interactive, group sessions.	279	9	AA: 100 %	-	Site 1, which received the intervention during phase 1, showed the greatest increase in condom use [linear and quadratic trends significant; t(1, 255)=3.28; p=0.0011 and t(1, 255)=–2.52; p=0.0119, respectively].	25
Dancy et al.[100]	Other	Low-income (F)	Midwest	Multi, didactic + interactive, group sessions.	280	3, 6,9	AA: 100 %	-	Risk data provided in aggregate (i.e. number of partners, condom use). Protective sexual behaviors increased in the intervention group from a mean score of 1.61 to 2.05 at 9 months (p<0.002), however scores did not change appreciably in the control group over time.	18
Health Worker Delivered										
Cohen et al.[101]	Other	Low-income (F)	N/A	Multi, didactic, group sessions	199	2	L: 91 %, AA: 8 %	-	No direct results reported for condom use.	22
DiClemente and Wingood[102]	RCT	Low-income (F)	San Francisco, CA	Multi, didactic + interactive + Skills, group sessions	128	3	AA: 100 %	-	Increase in consistent condom use by intervention group (OR 2.1; 95 % CI, 1.03 - 4.15; P=0.04).	27

Table 6. (continued)

Reference	Design	Target	Region	Intervention	Sample Size	Follow-up (mo.)	Race	BMO*	Results	Score
Ehrhardt et al.[49]	RCT	Vulnerable (F) (Family planning clinic)	Brooklyn, NY	1) Multi, didactic + interactive, group sessions; 2) Abridged version of 1	360	1, 6, 12	AA: 73 %, L: 17 %, O: 10 %	-	At 1-month, both interventions yielded improved or maintained safe sex behavior (d=0.36, 95 % CI 0.04, 0.69 and d=0.30, 95 % CI 0.00, 0.61, respectively). Results diminished by 12 months.	25
Hobfoll et al.[103]	RCT	Low-income (F) (pregnant)	Akron, OH	Multi, didactic + skills, group sessions	206	6	AA: 57 %, O: 3 %	-	Critical difference among means for the Dunn-Sidak multiple comparison procedure were significant of 2.444 between intervention and control (α=0.05).	18
Jemmott et al.[104]	RCT	Vulnerable (F) (women's health clinic)	Newark, NJ	1) Single, didactic, 1-on-1 session; 2) 1+ interactive + skills; 3) Single, didactic + interactive, group session; 4) 3 + skills	564	3, 6, 12	AA: 100 %	+	At 12 months, Intervention 4 reported less unprotected sex than the other intervention groups [Cohen's d=0.23; p=0.02], and was less likely to report an incident STI than controls (d=0.20; p=0.03).	26
Kelly et al.[105]	RCT	Vulnerable (F) (primary health care clinic)	Milwaukee, WI	Multi, didactic + interactive + skills, group sessions	197	3	AA: 87 %, O: 4 %, L: 3 %	-	Condom use increased from 26 % to 56 % in the intervention group, while no change was seen in the control group (p <0.001).	17
Lindenberg et al.[106]	RCT	Low-income (F)	Georgia	Multi, didactic, group sessions	56	3	L: 100 %	-	Condom use at last sex increased among single (71.4 % to 92.9 %) and partnered (11.1 % to 19.4 %) women (no other relevant statistics provided).	23
Peragallo et al.[107]	RCT	Low-income (F)	Chicago, IL	Multi, didactic + interactive + skills, group sessions	454	6	L: 100 %	-	A greater proportion of the intervention group reported always using condoms (23 %) compared to the control group (17 %) at 6 months, however the difference was not significant (p=0.141). The effect size calculated using Hedge's g method was 0.17.	21
St. Lawrence et al.[108]	RCT	Low-income (F)	Atlanta, GA	1) Multi, didactic, group sessions; 2) 1+skills observation; 3) 2+skills practice	445	3, 6 12	AA: 100 %	-	No effect size analyses provided (F=5.81; p <0.005). The percentage of condom-protected intercourse occasions increased from 44 % to 54 % at the 6-month follow-up, then declined to 49 % after 1 year.	25

RCT—Randomized controlled trial; Pre/Post—Pre-test/Post-test; F—Female; M—Male; AA—African American; L—Latino/a; O—other ethnicity/race; BMO—Biomarker outcome
**In addition to condom use; Biomarkers include incident sexually transmitted infection, and incident HIV where indicated*

Table 7. HIV Prevention Interventions Targeting Other Populations (n=10)

Reference	Design	Target	Region	Intervention	Sample Size	Follow-up (mo.)	Race	BMO*	Results	Score
Digitally Delivered										
Alemagno et al.[109]	RCT	Incarcerated	Ohio	Single, didactic, one-on-one session	212	2	AA: 69 %	-	Intervention group with increased report of sex without condom compared with baseline (62.3 % pre-intervention and 81.5 % post-intervention; $p<0.05$).	23
Peer Delivered										
Cohen et al.[23]	Pre/Post	Community (everyone)	New Orleans, LA	State-wide condom social marketing intervention	1507 survey-ed	24	AA: 42 %,	-	Increase in condom use at last sex for AA women with ≥2 sex partners at one (39 %; $p=0.1$) and two years (48 %; $p<0.001$) compared with baseline (30 %).	15
Nyamathi et al.[110]	RCT	High-risk (F) + intimate partner	Los Angeles, CA	1) Multi, didactic+ interactive + skills, group sessions; 2) Health worker delivered; Multi, didactic + interactive + skills, group sessions.	633	6	AA: 65 % L: 26 %	-	The portion of subjects engaging in unprotected sex decreased in all groups (Control from 62 % to 53 %, Intervention 1 from 64 % to 56 %, and Intervention 2 from 79 % to 59 %; $\chi^2=26.27$; $p<0.0001$). There was no significant difference in the decrease of unprotected sex between the control group and either Intervention 1 (B=0.04; $P=0.70$) or Intervention 2 (B=-0.10; $p=0.88$)	20
Health Worker Delivered										
El-Bassel et al.[111]	RCT	Serodiscordant couples	New York, NY; Atlanta, GA; Los Angeles, CA; Philadelphia, PA	Multi, interactive, 1-on-1 + group sessions	535 couples	6, 12	AA: 100 %	+	Intervention group with increased proportion of consistent condom use (RR 1.45; $p<0.001$) over 12 months. No difference in cumulative STI incidence between groups (RR 0.98).	25
Linn et al.[112]	RCT	Homeless shelter (M)	Nashville, TN	Multi, interactive + skills, group sessions	257	1.5, 3, 4.5, 6	AA: 59 %, L: 6 %	-	The mean risk score (based on unprotected sex) was significantly lower in the intervention (1.1) than in the control group (3.2; t=2.64; $p=0.01$).	26
Nyamathi et al.[113]	RCT	Homeless shelter/Drug recovery program (F)	Los Angeles, CA	Multi, didactic, group sessions for 1) women only; 2) women + a supportive person; 3) 1 + interactive + skills; 4) 2 + interactive + skills	241	6, 12	AA: 91 %	-	All groups with decrease in unprotected sex at 12 months ($\chi^2=55.47$; $p<0.001$). No significant difference in condom use by intervention condition overtime was found.	18
Nyamathi and Stein[46]	RCT	Homeless shelter/Drug recovery program (F)	Los Angeles, CA	Single, didactic + interactive + skills, group session	345	24	AA: 100 %	-	Risk data provided in aggregate (condom use and number of partners). HIV risk behavior decreased in both cohorts (Z-score -5.34 in the intervention cohort and -7.49 in the control cohort; $p<0.001$). Comparison of the two cohorts at year 2 revealed no significant difference (Z-score -1.41).	21

Table 7. (continued)

Reference	Design	Target	Region	Intervention	Sample Size	Follow-up (mo.)	Race	BMO*	Results	Score
Otto-Salaj et al.[114]	RCT	Patients with psychiatric diagnosis	Milwaukee, WI	Multi, didactic, group sessions	189	3, 6, 9, 12	AA: 51 %, L: 6 %	-	Women in the intervention group had a greater increase in condom use than those in the control group at 9 months (mean occurrence from 0.38 to 2.83; t=2.10, $p<0.04$). There was a significant interaction effect between intervention condition and gender over time ($\chi^2=21.73$, $p<0.001$), and men in both conditions exhibited no significant increase in condom use.	19
El-Bassel et al.[115]	RCT	Couples	Bronx, NY	Multi, interactive, dyadic sessions	81 couples; 136 women	12	AA: 54 %, L: 38 %	-	Women who received intervention, with or without partner not significantly more likely to report 100 % condom use (adjusted OR 1.72; $p=0.14$).	24
Harvey et al.[116]	RCT	Couples	Los Angeles, CA	Multi, Interactive + skills, dyadic sessions	146	3,6	L: 100 %	-	Increased condom use at 3 months compared with baseline in both intervention (43.6 % vs. 23.6 %) and control (44.2 % vs. 36.5 %) ($p\leq0.01$); no significant difference between groups.	20

RCT—Randomized controlled trial; Pre/Post—Pre-test/Post-test; F—Female; M—Male; AA—African American; L—Latino/a; O—other ethnicity/race
**In addition to condom use; Biomarkers include incident sexually transmitted infection, and incident HIV where indicated*

STD Clinic Patients

We identified 16 studies examining interventions targeting patients seeking care in STD clinics. STD clinics serve a high-risk population that, by virtue of having acquired an STI, has demonstrably been failed by previous interventions. As with adolescents, many successful interventions integrate condom use instruction and negotiation skills with culturally specific motivation to employ safe sex practices. For women, a multi-session intervention that incorporated education regarding STIs, the mechanics of condom use, and condom negotiation skills resulted in a decrease in STI acquisition in African American and Latina women at 12 months of follow-up, compared with routine STI care. Of note, the implementation was culturally tailored to the target population and facilitators were matched by ethnicity to participants, however racial subgroup analyses were not performed.[36]

Unlike adolescent-targeted programs, successful interventions among STI clinic patients may leave out condom application instruction and focus solely on the skills of *negotiating* condom use. Presumably this is because STD clinic populations are older, and neglect to use condoms on account of various social and cultural implications rather than a lacking skill set. In a landmark multicenter prospective trial published in 1998, subjects exposed to both a four-session theory-based intervention and a brief two-session interactive counseling intervention demonstrated a 20 % lower risk of subsequent STI acquisition than subjects who received standard STI care at 12 months of follow-up, but only those who received the four-session intervention reported an increase in condom use compared with the control group at six months.[37] Neither intervention included instruction on the mechanics of condom use, but focused instead on motivating condom use and negotiating safe sex. The subjects in this trial were African American (59 %) and Latino (19 %), though no racial subgroup analysis was conducted and race-specific content was not included.[37,38]

As with adolescents, interventions that employ the above insights with video or digital implementation have been developed in recent years. Video interventions, although limited due to a lack in interactivity, do offer the benefit of ease of implementation.[39–41] Computer technology may overcome some of the limits of video interventions due to its interactive nature; one computerized intervention for STI clinic patients was designed to customized the material provided based on a patient's baseline sexual risk and willingness to change behavior. This program resulted in an increased proportion of subjects reporting consistent condom use at 6 months and decreased proportion with recurrent STIs.[42]

High-risk Men

African American men who have sex with men (MSM) have had disproportionately high rates of HIV infection for

some time[43], yet we only identified a single intervention targeting this at-risk population. Of note, this intervention was not evaluated in a randomized control trial. This four-session intervention resulted in a significant decrease in the proportion of men reporting unprotected anal intercourse after three months of follow-up, as well as a decrease in the number of male and female partners with whom the respondents reported engaging in unprotected intercourse.[44] This study was significantly limited by its small size, the substantial proportion of men who were lost to follow-up, and the lack of a control intervention. A second intervention targeting Latino migrant MSM was identified, and involved training community representatives to be *promotores* (promoters) of safe sex behaviors. Serial surveys of community members over two years demonstrated an increase in the proportion of protected anal intercourse.[24] However, other interventions were simultaneously implemented in the community and the observed increase in protected sexual intercourse cannot be attributed to this intervention alone.

High-risk Women

We identified five studies evaluating interventions which primarily targeted high-risk women. Similar to the results observed in other populations, these studies suggest that cultural targeting and explicit skills instruction play an important role in determining intervention success. The relative importance of cultural targeting and skills-building, however, may depend on the specific sub-population of high-risk women targeted.[45,46] For example, Raj et al. found that an HIV-intensive intervention targeting Latinas that featured condom negotiation exercises and further empowerment-based teaching, as well as a culturally tailored general woman's health intervention featuring condom-negotiating exercises were able to improve condom use rates.[47]

DISCUSSION

We identified a large number of relevant studies, targeting different behaviors and conditions that place populations at risk for HIV. Given the heterogeneity of study designs and populations, sweeping conclusions are difficult. However, several salient points are worth noting. First, there were no studies specifically aimed to reduce disparities in HIV acquisition or risk behavior between racial/ethnic categories. This may be due to changes in the populations most affected by HIV, or perhaps targeting racial/ethnic minorities implies a reduction in disparities. Second, few interventions utilized HIV incidence as a primary endpoint, and those that did had negative findings. Third, very few of the identified interventions targeted men who have sex with men, the group currently at highest risk for HIV in United States. Finally, for interventions measuring behavior change, educational interventions alone did not cause meaningful change; rather, successful interventions incorporate the teaching of specific skills necessary to initiate and maintain behavioral change, and interactive interventions are superior to interventions which depend on the passive acquisition of knowledge.

Although interventions need not be specifically designed for one racial or ethnic minority, the use of peers or lay health workers of the minority population of interest allows for nuanced customization of the intervention design and leads to increased acceptance of suggested behavioral changes among target populations. Peer or lay health worker-based interventions linked to a clinical setting appeared to have better outcomes among adolescents than other study groups. Interventions varied across population categories as to whether the matched interventionists were at the level of health care staff, facilitators, or peer educators. Interestingly, only one study explicitly compared the importance of racial matching in a video intervention[48], and no study specifically compared racially matched compared with unmatched implementers for interventions delivered in person.

Two previous meta-analyses comparing the results of interventions with four or more sessions to those requiring fewer sessions have concluded that interventions with four or more sessions were more effective than interventions with fewer sessions.[13,14] However, none of the studies included in these prior reviews directly manipulated the number of sessions as part of the trial. We identified two studies that directly examined number of sessions; one found no difference in intervention effects across groups assigned to two versus four sessions,[37] and the other found that patients randomized to an eight-session intervention had significantly better outcomes than zero-session controls, while those assigned a four-session intervention did not.[49] Darbes's meta-analysis of African American heterosexuals found that interventions were more effective if they were skill-based, peer-based, and culturally tailored for African Americans.[12] Herbst's meta-analysis of 20 interventions among Latinos found significantly greater efficacy associated with interventions that included problem-solving skills coaching, that did *not* use peers, and that addressed the influences of *machismo*.[13] We extend the results of previous reviews by including a number of articles published in the last few years; the 2007 review by Crepaz et al. only includes articles published through June 2005,[10] while our review includes 18 articles published since, including six interventions targeting adolescents, four targeting STD clinic patients, and the only two interventions identified in our review targeting high-risk men. Also, 10 of the studies in our review describe interventions not tested in random-

ized control trials. The majority of these non-randomized studies followed a pre- and post-intervention observational design. Of note, this included both of the interventions targeting high-risk men and four studies targeting vulnerable women.

Our conflicting results regarding the benefits of peer-based versus health worker-based interventions may result from confounding by ethnicity. A previous meta-analysis designed to examine this very topic across various populations (including internationally) found that health-worker-based interventions were more efficacious, but that effective interventions were more likely to match health-worker ethnicity with that of the target audience.[50]

We did not identify any study that specifically listed implementation costs or that performed a cost-effectiveness analysis. We highlighted above the interventions which require minimal personnel time or training, but this is at best a proxy for the true cost of an intervention. Future intervention evaluations should attempt to estimate the expected cost of implementation in order to facilitate cost-effectiveness comparisons between HIV prevention interventions for community providers, a point which has been made by authors of previous meta-analyses in this field.[13] In an era of shrinking public health budgets,[51] digital interventions can be expected to be a growing area of interest as a method of inexpensively promoting HIV prevention.

In the international setting, biologic interventions such as circumcision and pre-exposure prophylaxis with systemic or topical antiretrovirals have been evaluated. We did not find any published studies implementing such interventions in minorities in the United States. The 2010 iPrEx pre-exposure prophylaxis study included two U.S. sites, but since these sites accounted for less than 10 % of the total study cohort and site-specific analysis was omitted, this study did not fit our inclusion criteria.[8] Finally, we note a significant lack of interventions targeting high-risk men, MSM in particular. Many of the studies that targeted STD clinic populations may have included some MSM, however, study participants were not stratified by sexual preference, and no part of the interventions specifically targeted MSM. This may be due to a number of reasons including accessibility of these men, and perhaps a long-standing focus on white MSM.

Our review features a number of limitations, foremost being those of scope. This review focused on clinic-based interventions and may have excluded a number of effective interventions that were implemented entirely in community settings. Furthermore, possibly effective interventions that were only assessed via intermediate outcomes such as intention to use condoms were not included. However, interventions that utilize proximate measures often do not correlate with biomedical outcome measurements such as incident STIs or HIV infection.[15,52] Publication bias of mostly effective studies may have excluded other studies that used HIV incidence as an outcome from our review. Also, we only included studies targeting drug users which sought to reduce sexual acquisition of HIV, excluding such interventions as the provision of sterile hypodermic syringes, because we could not disentangle the mechanism of transmission in this population and had to rely on reported condom use. Potential biases due to study duration were not assessed and our analysis was not powered to detect a statistical difference between study quality and publication date. Comparing our review to other reviews is limited by the use of a unique modification of the DB scoring system used in this symposium which was chosen to allow the evaluation of both randomized and non-randomized studies.[53] However, the original DB system has been used extensively by reviews in other health settings, with the original paper having been cited over 800 times since publication. It is worth emphasizing that the DB scoring metric evaluates the quality of the study evaluating an intervention, not the intervention itself. Our modification to the DB system to de-emphasize the importance of power calculations does complicate direct comparisons with previous uses of the scoring metric, but was done because many studies omit results of power studies in their texts.[54]

In summary, interventions which incorporate the teaching of specific skills necessary to initiate and maintain behavioral change, and interactive interventions are superior to interventions which depend on the passive acquisition of knowledge. Peer-based interventions seemed to be more effective in adolescents compared to other groups. Serious lacunae in interventions that target minority MSM and a total lack of interventions designed to reduce disparities was evident. Future work should seek to fill these gaps as well as adapt current interventions effective in minority populations to include forthcoming biomedical HIV/AIDS interventions where appropriate.

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Corresponding Author: *John A. Schneider, MD MPH; Department of Health Studies, University of Chicago, 5841 S. Maryland Ave., MC 5065, Chicago, IL 60637, USA (e-mail: jschnei1@medicine.bsd.uchicago.edu).*

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