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Sexual Risk Reduction Interventions for Patients Attending Sexually Transmitted Disease Clinics in the United States: A Meta-Analytic Review, 1986 to Early 2009

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Abstract

Background—Sexually transmitted disease (STD) patients are more likely to experience a future STD including HIV.

Purpose—To examine the efficacy of behavioral interventions to reduce sexual risk behavior and incident STDs among patients attending STD clinics in the United States.

Methods—Meta-analysis of 32 studies with 48 separate interventions targeting STD patients (N = 67,538). Independent raters coded study, sample, and intervention characteristics. Effect sizes, using both fixed- and random-effects models, were calculated. Potential moderators of intervention efficacy were assessed.

Results—Relative to controls, intervention participants increased their condom use and had fewer incident STDs, including human immunodeficiency virus (HIV), across assessment intervals (d_{+s} ranging from 0.05 to 0.64). Several sample (e.g., age, ethnicity) and intervention features (e.g., targeting intervention to a specific group) moderated the efficacy of the intervention.

Conclusions—Behavioral interventions targeted to STD clinic patients reduce sexual risk behavior and prevent HIV/STDs. Widespread use of behavioral interventions in STD clinics should be a public health priority.

Keywords

HIV/STD; condom; sex; meta-analysis; behavior; prevention

Sexually transmitted diseases (STDs) remain a major public health concern. The Centers for Disease Control and Prevention (CDC) estimates that 45 million Americans have been infected with genital herpes, 20 million with human papillomavirus (HPV), and more than 1 million with HIV. The annual incidence of HPV exceeds 6 million, trichomoniasis exceeds 7 million, and HIV newly infects more than 56,000 (1). Untreated STDs can result in pelvic inflammatory disease, chronic pelvic pain, ectopic pregnancy, birth complications, and infertility among women, and epididymitis and urethritis among men (2,3). Moreover, untreated STDs substantially increase the risk of both acquisition and transmission of HIV (3–5). In addition to the health consequences, STDs pose a huge economic burden to the U.S. health care system with an estimated direct cost of $15.3 billion annually (3). To reduce the health and economic burden of STDs, the CDC has called for the expansion of prevention efforts (3). Fundamental to expanded prevention efforts is the identification and evaluation of successful STD

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prevention and intervention programs in reducing sexual risk behavior, STD acquisition, and HIV transmission.

STD clinics provide an opportune setting for evaluating sexual risk reduction prevention efforts. Patients attending STD clinics are known to engage in risky sexual behavior and other health behaviors (e.g., alcohol and drug use) that facilitate the acquisition of STDs, including HIV (6,7). Not only do STD clinic patients report riskier sexual behaviors, they are more likely to return with a subsequent STD (8,9). Moreover, they are at increased risk of HIV infection relative to the general population (10,11). Compared with uninfected individuals, people with untreated STDs are two to five times more at risk of contracting HIV through sexual contact (3,4). Because patients at STD clinics are more susceptible to HIV, and STDs increase the risk of transmitting HIV to a sexual partner (3), identifying successful intervention strategies among STD clinic patients is critical in the prevention of HIV and other STDs.

To prevent sexually transmitted infections, the CDC recommends a comprehensive approach to STD prevention that includes early STD diagnosis, treatment, and behavioral intervention (3). Evaluating the efficacy of behavioral interventions to reduce sexual risk among STD clinic patients is essential to improving comprehensive prevention efforts. Several literature (12) and meta-analytic reviews (13,14) have evaluated the efficacy of behavioral interventions to reduce sexual risk behavior and incident STDs among clinic patients. In general, these reviews found behavioral interventions were successful at increasing condom use among treatment patients relative to controls; however, findings for incident STDs were inconsistent (or could not be determined). For instance, DiClemente et al.'s (12) review of clinic-based sexual risk reduction interventions among adolescents ($k = 9$) could not investigate the efficacy of behavioral interventions to reduce STDs due to the lack of inclusion of STDs as an outcome, whereas Ward et al. (14) found a reduction in incident STDs among patients in studies reporting clinical diagnoses ($k = 3$) but not for those studies reporting laboratory confirmed STDs ($k = 8$). Reduction in incident STDs ($k = 13$) was found in a meta-analysis of 18 randomized controlled trials (RCTs) focusing on Black and Hispanic STD clinic patients in the United States (13). Although these reviews do provide evidence that behavioral interventions are efficacious at reducing sexual risk behavior (i.e., condom use) and incident STDs among some STD clinic patients (i.e., Blacks and Hispanics in the United States), it is unclear whether incident STDs are improved in broader samples of patients. Furthermore, these reviews did not (or could not) address number of sexual partners, which is associated with the prevalence of STDs. Finally, efficacy of behavioral interventions among STD clinic patients were based on the longest assessment interval, ranging from 3 to 12 months post-intervention, rather than examining the durability of the interventions over time.

The purpose of the current study was to use meta-analytic techniques to systematically evaluate the efficacy of behavioral interventions when implemented with STD clinic patients. We extend prior reviews of behavioral interventions for STD clinic patients by using a larger sample of studies ($k = 32$) to address the aforementioned limitations. Specifically, we include studies sampling any patients attending U. S. STD clinics, examine both condom use and number of sexual partners, and assess longer-term outcomes (i.e., up to 2-years post-intervention). Intervention success was measured with four outcomes: (a) condom use, (b) number of sexual partners, and (c) incident STDs, including (d) HIV. We hypothesized that STD clinic patients who received a sexual risk reduction intervention would show increases in condom use, report fewer sexual partners, and would be less likely to acquire STDs, including HIV, relative to control participants.

We also examined the durability of intervention improvements and the extent to which efficacy depended upon participant or intervention characteristics. Moderators included (*a*) age, race, and gender, (*b*) baseline STD diagnosis, (*c*) intervention content (tailored or targeted,

motivation and skills training), and (*d*) intervention length. We hypothesized that interventions would be more efficacious when they (*a*) sampled greater proportions of those who bear the heaviest burden of STDs (3)—namely, young adults (ages 15 to 24), Blacks, and women; (*b*) sampled patients diagnosed with a STD, as they may be more motivated to initiate sexual risk reduction than uninfected patients; (*c*) targeted motivation and provided skills training, consistent with the Information-Motivation-Behavioral Skills Model of HIV-prevention (15, 16); (*d*) tailored content to the individual or targeted content toward a specific group (e.g., gender), thus increasing message relevancy (17); and (*e*) were of longer duration, providing additional time to develop risk reduction skills (15,16).

METHODS

Search Strategy and Study Selection

A comprehensive search strategy was used to obtain relevant studies. Studies were retrieved from (*a*) electronic databases (PsycINFO, PubMed, Dissertation Abstracts, ERIC, CINAHL, and The Cochrane Library) using a Boolean search strategy with the following terms: (HIV *OR* AIDS *OR* (human *AND* immu* *AND* virus) *OR* (acquired *AND* immu* *AND* deficien* *AND* syndrome)) *AND* (prevent* *OR* interven*) *AND* (condom* *OR* sex*) *AND* ((sexually and transmitted and infection*) OR (sexually and transmitted and disease*) OR STI OR STD)) *AND* (clinic OR hospital OR healthcare OR center OR infirmary OR dispensary)), (*b*) reference sections of relevant manuscripts, (*c*) electronic content of professional journals, and (*d*) electronic database searches for manuscripts authored by researchers with relevant funding (i.e., list of principal investigators retrieved from the CRISP database [now known as the NIH RePORTER]). To optimize thoroughness, we conducted the database search at study onset (September 2008) and upon completion of the initial coding (February 2009).

Studies were included if the author(s) (*a*) examined an individual- or group-level behavioral intervention intended to reduce sexual risk behavior and the risk of STDs, including HIV, (*b*) sampled patients attending a STD clinic in the United States, (*c*) used a randomized controlled trial (RCT) *or* a quasi-experimental design reporting pre-test outcomes (used to evaluate the equivalence of the treatment and control participants) with a comparison condition, (*d*) assessed sexual risk behavior or STD acquisition, and (*e*) provided information needed to calculate effect sizes. Studies were excluded if they (*a*) did not focus on improving individual-level sexual risk behaviors, (*b*) sampled patients from other locations (e.g., community agency), (*c*) included samples with greater than 50% HIV-positive patients (because these individuals require more comprehensive care, including interventions that focus on secondary prevention of HIV transmission rather than STD prevention), (*d*) used a within-subjects design with no comparison condition, or (e) evaluated a strictly structural-level (e.g., mass media) intervention. When authors reported details and/or outcomes in multiple manuscripts, the studies were linked in the database and represented as a single study. If a study reported on more than one comparison condition, the comparison condition with the least contact (e.g., wait-list) was used. When author(s) reported insufficient details, they were contacted for information. Of the three authors contacted, 100% responded resulting in the retention of two studies and the exclusion of one study. Studies that fulfilled the selection criteria and were available by March of 2009 were included. Thus, we included 32 manuscripts with 48 separate interventions (Figure 1).

Coding and Reliability

Two independent coders [LAJSS, RLF] rated the study information, sample characteristics (e.g., sex, ethnicity), design and measurement specifics (e.g., number of follow-ups), and details of the control and intervention condition(s) (e.g., number of sessions, STD testing and treatment, provided condoms). Based on the Information-Motivation-Behavioral Skills Model

of behavior change (15,16), intervention content included information (STD *or* HIV education), motivation (risk feedback such as STD-knowledge scores, risk awareness, assessments of the pros and cons of sexual risk behavior, attitudes toward condom use *or* partner reduction, and transsituational motivational factors such as life goals, personal and/or community values), and behavioral skills (condom, communication, and self-management [i.e., planning and/or goal setting] skills). Finally, we evaluated whether the intervention content was tailored (content altered for a specific individual, e.g., addressing specific sexual risk reduction knowledge deficits) or targeted (i.e., content altered for a specific sub-group, e.g., focused on women-specific risks associated with STD transmission) based on Kreuter and Wray's (17) description of tailored and targeted health communication.

Methodological quality for each study was assessed using 12 items (e.g., random assignment) from validated measures (18,19); scores range from 0 to 17. Twenty studies were randomly selected to assess inter-rater reliability. For the categorical variables, raters agreed on 59% to 100% of the judgments (mean Cohen's $\kappa = .71$). Reliability for the continuous variables (calculated using the intraclass correlation coefficient; ρ) yielded an average $\rho = .93$ across categories (median = 1.00). Disagreements between coders were resolved through discussion.

Study Outcomes

For each study, effect size estimates were calculated for condom use (or unprotected sex), number of sexual partners, and incident STDs, including HIV. Studies assessed *condom use* using a variety of measures (e.g., condom use at last sex, proportion of unprotected sexual events) for vaginal and anal sex. Thus, *condom use* included protected or unprotected vaginal, anal, or unspecified sex. Because none of the investigators measured the *number of sexual partners* separately by partner type, *number of sexual partners* refers to the number of any type of sexual partner over a specified interval. (Studies typically did not report on partner concurrency so this could not be coded.) *Incident STDs* refers to laboratory- or clinically-diagnosed STDs. Laboratory-confirmed new HIV infections comprised *Incident HIV*.

Effect Size Derivation

Because the majority of the author(s) reported continuous measures, effect sizes (d) were defined as the mean difference between the treatment and control groups divided by the pooled standard deviation (20). When means and standard deviations were not provided, other information (e.g., t or F test) was used (21). If a study reported dichotomous outcomes, we calculated an odds ratio and transformed it to d using the Cox transformation (22). If no statistical information was available (and could not be obtained) and the author(s) reported no significant between-group differences, we estimated that effect size as zero (21). (Of the 184 effect sizes calculated, 8 were estimated as zero.) In calculating d, we controlled for baseline differences when pre-intervention measures were available (23). All effect sizes were corrected for sample size bias (24). Positive effect sizes indicated more risk reduction, that is, participants receiving the intervention increased their condom use, decreased their number of sexual partners, and had fewer incident STDs or HIV infections compared to controls.

Multiple effect sizes were calculated from individual studies when they had more than one outcome, multiple intervention conditions, or when outcomes were separated by sample characteristics (e.g., gender). Effect sizes calculated for each intervention and by sample characteristic were analyzed as a separate study (21). When a study contained multiple measures of the same outcome, the effect sizes were averaged (with corresponding sample sizes averaged). Two authors independently calculated effect sizes using DSTAT 2.0 (25); discrepancies were examined for errors and corrected.

Timing of post-intervention assessments varied with the first assessment occurring between 0 to 64 weeks (k = 46), the second at 13 weeks (k = 1), and a third assessment at 26 weeks (k = 1). To avoid violating the assumption of study independence and as a strategy to examine all study assessments, effect sizes were clustered into three intervals: (a) short-term (4 to 13 weeks; k = 35), (b) intermediate (22 to 39 weeks; k = 29), and (c) long-term (52 to 104 weeks; k =20) on the basis of natural clusters of assessments on a stem-and-leaf plot (available from the authors).

Statistical Analysis

All dependent variables were examined for outliers (26); for each variable and assessment interval, extreme effect sizes (i.e., effect sizes more than 2 standard deviations from the mean) were recoded to be equivalent to the value at 2 standard deviations (i.e., winsorizing) (21). Of the 184 effect sizes, 7 outliers were detected (4% of the total number of effect size estimates). Weighted mean effect sizes, d_+, were calculated using fixed- and random-effects procedures (21). The homogeneity statistic, Q, determined whether each set of d_{+S} shared a common effect size. The homogeneity of variance statistic has an approximate chi-square distribution with the number of effect sizes (k) minus 1 degrees of freedom (27); a significant Q indicates a lack of homogeneity. To further assess homogeneity, the I^2 index (ranging between 0 and 100%) and its corresponding 95% confidence intervals (CIs) were calculated (28,29). If the 95% confidence interval around I^2 includes zero, the set of effect sizes is considered homogeneous.

To explain variability in effect sizes, the relation between sample, methodological, or intervention characteristics and the magnitude of the effects were examined using modified weighted least squares regression analyses (following fixed-effects assumptions) with weights equivalent to the inverse of the variance for each effect size (21,30). Univariate regression analyses examined *a priori* determined moderators of condom use effect sizes at all assessments. Sample characteristics (age group, sex, ethnicity, STD diagnosis), intervention content (provided motivation or behavioral skills including condom distribution), features of the intervention (individually tailored or group targeted content), and intervention dose were examined. To control for Type I error, we used the Bonferroni correction to adjust the P-values, in this case P = .005. Significant univariate moderators were simultaneously entered into multiple regression models to test for unique variance. Multiple regression analyses were conducted only for outcomes with sufficient effect sizes per moderator (i.e., > 5 cases per independent variable). For the multiple regression analyses, continuous variables (e.g., proportion women) were mean-centered to reduce multicolinearity. Analyses were conducted in Stata 10.0 (31) using macros provided by Lipsey and Wilson (21).

Publication Bias

We tested for publication bias (i.e., when studies with significant findings are published, whereas studies with non-significant findings remain unpublished; the file-drawer effect (32)). We examined our data for publication bias by (a) generating and inspecting funnel plots of the weighted mean effect size by standard error (33) and (b) systematically examining funnel plot asymmetry using two methods: non-parametric (estimating the correlation between a standardized effect size estimate and its variance) (34) and linear regression (standardized effect size estimate is regressed against its precision, defined as the inverse of the standard error) (35,36).

RESULTS

Study, Sample, and Intervention Details

Table 1 provides sample and intervention details for the 32 included studies. Studies appeared between 1991 and early 2009 (median publication year was 1999). Methodological quality

(MQ) of the studies ranged from 7 to 15 (*mean* = 10.52; *median* = 11; SD = 1.99). Publication year and MQ score were correlated ($r = 0.39$, $P = .03$) with newer studies (studies published in or after the year 2000) of higher quality (median score = 11) than older studies (median score = 10).

All studies were conducted in the United States: 28% Southwest, 25% Southeast, 16% Northeast, 9% Midwest, 6% Northwest and 16% conducted in multiple regions. Of the 67,538 participants sampled (median = 392 participants), 46% were women, 72% Black, and mean age was 25.80 (SD = 5.75; range = 17 to 35; 41% age 24 and under). Several studies targeted women (25%; k =8) or Blacks (19%; k =8). Most studies (72%) restricted participation to patients who had a STD (37.5%; self-reported or diagnosed via a clinical exam and/or laboratory test), were at elevated risk of contracting a STD (16%; e.g., multiple sexual partners, unprotected sex) or both (9%). Of the 23 studies reporting baseline STDs, current STD diagnosis was confirmed via clinical exam or laboratory test in 69% (median = 88%, range = 16 to 100%; 9 studies restricted their samples to only those with current STDs) of participants.

Interventions were typically conducted in one session (56%; range = 1 to 7) lasting a median of 44 minutes (range = 12.5 to 210 minutes). Most interventions (62.5%) occurred during the clinic visit (either simultaneously or immediately after); 37.5% were scheduled for a later time. Facilitators delivered the intervention via individuals (k = 22), small groups (k = 19), or both individually and small groups (k = 7). Many interventions were individually tailored to the patient (42%) and 31% were targeted to a group (e.g., ethnicity, gender). Intervention content included STD testing and counseling (98%), education (85%), skills training (85%; interventions included 75% condom, 56% self-management [i.e., planning and/or goal setting], and 58% communication skills), and motivational components (79%; 60% risk awareness, 33% risk feedback, 31% attitudes toward condom use and/or reducing the number of sexual partners, 23% transsituational motivational factors, and 15% assessing pros and cons of risk behavior). Only 40% of the interventions specifically reported providing condoms to patients. Comparison conditions were most often an active comparison (83%; e.g., STD/HIV education, brief form of the intervention); only 17% used an assessment-only control. Active comparisons met with a facilitator for a single session (range = 1 to 2) of a median of 15 minutes (range = 5 to 180 minutes). Condoms were provided in 36% of the control groups.

Publication Bias

Visual inspection of the funnel plots (Figures A1 – A10, electronic supplementary materials) suggested that the effect sizes of the interventions represented for any outcome by assessment interval did not reveal a publication bias. More formal testing (see Table A1, electronic supplementary materials) using Begg's adjusted rank correlation (34) did not indicate a significant association between effect size estimates and variance for any outcome by assessment interval (Ps > .14). Results using Egger et al.'s (35) regression asymmetry test indicated that the intercept from the regression analyses did not differ from zero for any outcome by assessment interval (Ps >.18) except for number of sexual partners at short-term assessment ($P = .04$). To determine the number of non-significant unpublished studies necessary to reduce a significant result to non-significant, we calculated Rosenthal's fail-safe N (32) for number of sexual partners at short-term assessment. Results indicate that 84 interventions assessing number of sexual partners (within 3 months post-intervention) with non-significant results would be necessary to reverse the significant findings.

Overall Efficacy of the Interventions

Table 2 provides the weighted mean effect sizes, d_+, for the 20 studies (k = 34) reporting condom use outcomes (37–56), 15 (k = 28) reporting number of sexual partners (38–42,45, 47,[48],[50],51,53,55–58), 22 (k = 40) reporting incident STDs (37–40,47–52,54,55,57–66), and

5 ($k = 6$) reporting incident HIV (48,50,63,66,67). Overall, analyses indicate that risk reduction interventions showed small to medium improvements in condom use and reduced the number of sexual partners and incident STDs and HIV compared with controls. At short-term and intermediate assessments, intervention participants increased their condom use ($d_{+S} = 0.05$ to 0.09, random effects) compared to controls. Participants reduced their number of sexual partners at short-term assessment ($d_+ = 0.08$, random effects) compared to controls. At intermediate ($d_+ = 0.11$, random effects)and long-term ($d_+ = 0.10$, random effects) assessment, incident STDs were significantly reduced among intervention participants versus controls. Insufficient studies were available to examine incident HIV at short-term (39) and intermediate assessment (none); however, the incidence of HIV was significantly reduced among intervention participants at long-term ($d_+ = 0.64$, random effects). We found no difference between the intervention and control participants with respect to condom use at long-term assessment ($d_+ = 0.04$, random effects), number of sexual partners at intermediate and long-term assessment ($d_{+S} = 0.05$ to 0.09, random effects), and incident STDs at short-term assessment ($d_+ = -0.08$, random effects). The overall pattern of results was consistent using fixed- or random-effects assumptions.[1]

Except for number of sexual partners at short-term assessment, the hypothesis of homogeneity was rejected for each outcome across assessment intervals. Moderator tests were conducted to examine whether *a priori* determined sample, methodological, or intervention characteristics related to the variability in effect sizes (reported below). Specifically, we examined (*a*) age group (age ≥ 24 years vs. age < 24 years), race (proportion Black), and gender (proportion women), (*b*) baseline STD diagnosis (% clinically diagnosed with an STD at baseline), (*c*) intervention content (motivation and/or skills training component, providing condoms, and tailored or targeted content,), and (*d*) intervention length (total intervention dose). Due to insufficient sample size ($k = 5$), moderator tests were not conducted for incidence of HIV.

Moderators of Intervention Impact on Condom Use

Moderators of intervention impact on condom use are reported in Table 3. Interventions increased short-term condom use when (a) sampling younger participants (≤24 years of age), (b) condoms were provided, and (c) the intervention targeted a specific group. When entered simultaneously, targeting a specific group ($\beta = .47$, $P < .001$) remained significant. Intermediate condom use improved when researchers sampled participants diagnosed with a STD. At long-term assessment, interventions were successful in improving condom use when (a) sampling more participants diagnosed with a STD, (b) the intervention targeted a specific group and was not tailored to an individual and (c) was of longer duration. None of the moderators remained significant when entered simultaneously in the regression model.

Moderators of Intervention Impact on Number of Partners

Moderator tests for number of partners are reported in Table 3. Numbers of sexual partners were reduced at short-term assessment when studies sampled younger participants (≤24 years of age) and provided condoms. When entered simultaneously in a regression model, neither age nor condom provision remained significant. We found no significant moderators of number of sexual partners at intermediate assessment. At long-term assessment, interventions were efficacious in reducing the number of sexual partners when (a) sampling younger participants (≤24 years of age), fewer Blacks, more women, or participants diagnosed with an STD, (b) intervention content was not individually tailored but was targeting a specific group, and (c) interventions lasted longer. All other tests for moderators were non-significant (*P*s >.005;

[1]Insufficient variability in type of control condition for most dependent variables meant that comparisons between active comparisons and assessment-only controls were not possible. Among the dependent variables with sufficient variability for type of control, no significant differences were found.

Bonferroni adjusted *P*-value). Multiple moderator tests were not conducted at long-term assessment due to the small sample size ($k = 11$).

Moderators of Intervention Impact on Incident STDs

Table 3 provides results from the moderator tests of intervention impact on incident STDs. Interventions were successful at reducing the incidence of STDs at short-term when (a) sampling younger participants (≤24 years of age), more Blacks, fewer women, and more participants with a current STD, (b) content did not include motivation or skills training, (c) content was not individually tailored, and (d) interventions were shorter. Due to insufficient sample size ($k = 8$), multiple moderator tests were not conducted. At intermediate assessment, interventions were successful when fewer women were sampled and the intervention content included a motivational component. When entered simultaneously, both moderators remained significant (proportion women: $\beta = -.33$, $P < .01$; motivational component: $\beta = .29$, $P = .02$) and accounted for 26% of the variance. Interventions reduced the incidence of STDs at long-term when younger participants were sampled.

DISCUSSION

This meta-analytic review examined 32 manuscripts evaluating 48 behavioral interventions to reduce sexual risk behavior among 67,538 STD clinic patients in the United States. Behavioral risk reduction interventions succeeded at increasing condom use, reducing number of sexual partners, and lowering the incidence of STDs; however, the efficacy of these interventions to reduce sexual risk behaviors and incident STDs varied across assessment intervals. Interventions were successful in improving condom use and reducing numbers of sexual partners for durations of up to 40 weeks (average of 19 and 12 weeks for condom use and number of sexual partners, respectively). Moreover, intervention success for incident STDs was sustained over 104 weeks (average of 26 weeks) with an effect size of small magnitude ($d_+ = 0.10$). In the current meta-analysis, the sexual risk reduction interventions were most often compared with an active comparison rather than an assessment-only, wait-list, or no-treatment control. Prior research indicates that between-groups effect sizes are generally smaller when comparing an intervention to an active comparison relative to a no-treatment control (68). Nonetheless, the magnitude of effects for condom use, number of sexual partners, and incident STDs corroborates effects reported in previous meta-analyses (13,69).

The incidence of HIV over 64 weeks (average of 54 weeks) was significantly lower among intervention compared to control participants ($d_+ = 0.64$), an effect size of medium magnitude. Consistent with prior research documenting the increased risk of HIV among STD clinic patients (10,11), overall incidence of HIV was 0.06% (27 out of 46,571 U.S. STD clinic patients) compared with 0.02% in the general population (estimated incidence of HIV in 2006 was 56,300) (70). Moreover, STD incidence was significantly lower among the same intervention participants compared to control patients at long-term assessment ($d_{+\ \mathrm{random}} = 0.11$, 95% CI = 0.07, 0.14, $k = 5$). To our knowledge, this meta-analysis is the first to demonstrate the efficacy of behavioral interventions among STD clinic patients as measured with HIV incidence. Overall, these findings demonstrate that behavioral interventions reduce sexual risk among STD clinic patients.

Several sample and intervention characteristics moderated the impact of the intervention on condom use, number of sexual partners, and incident STDs. First, consistent with our hypothesis, interventions were more successful at improving condom use, reducing the number of sexual partners, and lowering incident infections at short-term follow-up when sampling younger rather than older patients. Reductions in number of sexual partners and incident STDs among younger patients were also observed at long-term follow-up. Because younger patients may have had fewer life experiences, they may be more amenable to health-related attitudinal

and behavioral changes relative to older patients whose behavior patterns are better established (71,72). Our findings suggest that sexual risk reduction behavioral interventions for younger patients should be routinely implemented in clinic settings.

Second, short-term reductions in incident STDs were found among studies sampling more men rather than women, contrary to our hypothesis. Compared to women, men often have greater relationship power and, as a consequence, men have greater control over sexual decision-making (73,74). To alleviate symptoms of STDs, male STD patients exposed to a sexual risk reduction intervention may be particularly motivated to engage in risk-reducing strategies with their female partners. (In the current study, more than two-thirds of the participants had an STD at baseline [49% of studies assessing incident STDs at short-term assessment]). Future research should explore motivational factors associated with STD diagnoses among men.

Third, interventions sampling more Blacks were less efficacious in reducing number of sexual partners at long-term follow-up but were more efficacious at reducing incident STDs at short-term follow-up, partially supporting our hypothesis. Explanations for these findings are necessarily speculative. One possible explanation relates to the targeting of the intervention based on race/ethnicity. Among the interventions assessing number of partners at long-term follow-up, only 3 (27%) of these interventions were specifically targeted to race. None of the interventions assessing incident STDs at short-term were targeted by race. Thus, these findings are difficult to interpret and warrant further investigation.

Fourth, consistent with our hypothesis, interventions were typically more successful when studies sampled patients diagnosed with a STD. Compared to uninfected individuals, patients with a current STD may be particularly motivated to change their sexual behavior (16). However, research examining the effects of STD diagnosis *alone* has found little change in sexual risk behavior compared with individuals not diagnosed with an STD (75,76). Thus, STD diagnosis by itself appears to be insufficient in changing sexual risk behavior. Future research might examine the interactive effects of STD diagnosis and intervention efficacy.

Fifth, as we expected, interventions were more successful at promoting condom use when the intervention content was targeted to specific subgroups. Theory (16,77), as well as previous research (13,14,78), suggest that targeting intervention content facilitates behavior change. We also found interventions that included a motivational component were less successful at reducing incident STDs at short-term but were more successful in reducing incident STDs at intermediate assessment. One possible explanation for this finding is the benefits of motivational enhancement hinged on interpersonal and condom use skill acquisition, which takes more time to emerge, consistent with the Information-Motivation-Behavioral Skills Model (15,79). The current findings suggest that interventionists developing HIV-prevention programs should conduct formative research to identify the specific needs of the population of interest.

Finally, interventions were more successful at improving sexual risk behaviors (condom use, number of sexual partners) at long-term follow-up when delivered in longer doses. Lengthier doses of intervention content may be necessary in the development of skills needed to enact and maintain behavioral change. A paradoxical finding was that intervention content delivered in shorter doses was more successful in improving incident STDs at short-term. It is possible that immediate change in incident STDs, rather than long-term maintenance, may be easier to achieve with briefer interventions. Furthermore, similar findings were found in a recent synthesis of meta-analyses examining behavioral interventions across multiple health behaviors (80). Nonetheless, this finding is difficult to explain and warrants further investigation.

Limitations

Several limitations should be considered when interpreting these findings. First, many outcomes involve self-reports, which are vulnerable to cognitive (e.g., memory) and social (e.g., self-presentation) biases (81,82). Self-report is imperfect, but most researchers employed methods designed to optimize the quality of these data. Furthermore, laboratory- and/or clinically-diagnosed STDs corroborate self-reported results. Second, the small number of studies available at each assessment interval could not support multivariate moderator tests for all outcomes. Moreover, our analyses are based largely on different sets of studies at each assessment and are not directly comparable across intervals. Thus, our moderator analyses should be considered preliminary.

CONCLUSION

Behavioral interventions implemented with STD clinic patients succeed at reducing sexual risk behaviors and incident STDs. These behavioral interventions reduce risk most among those who bear the heaviest burden of HIV (i.e., young adults and Blacks). If widely implemented, these interventions can help to lower long-term risk of incident STDs including HIV among patients, potentially reducing the health and economic burden of STDs. To increase their efficacy, researchers should consider including patients at most risk, targeting the content specifically for STD patients, including specific subgroups (e.g., young adults), and delivering intervention content in longer doses. Translating, enhancing, and implementing efficacious behavioral intervention among STD clinic patients should be a high priority.

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References

References marked with an asterisk indicate studies included in the meta-analysis.

References marked with a dagger indicate supplemental manuscripts providing intervention details and additional measurement occasions for the 32 included studies.

1. Centers for Disease Control and Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention. 2006 Disease Profile. 2008. [inclusive page numbers]
2. World Health Organization (WHO) . Global prevalence and incidence of selected curable sexually transmitted infections: Overview and estimates. Retrieved June 18, 2009; from http://www.who.int/hiv/pub/sti/who_hiv_aids_2001.02.pdf
3. Centers for Disease Control and Prevention (CDC). . Trends in reportable sexually transmitted diseases in the United States, 2007. Retrieved May 7, 2010, from http://www.cdc.gov/std/stats07/trends.pdf
4. Fleming DT, Wasserheit JN. From epidemiological synergy to public health policy and practice: the contribution of other sexually transmitted diseases to sexual transmission of HIV infection. Sex Transm Infect 1999;75:3–17. [PubMed: 10448335]
5. World Health Organization (WHO) . Global strategy for the prevention and control of sexually transmitted infections: 2006–2015. Retrieved June 18, 2009, from http://www.who.int/reproductivehealth/publications/rtis/RHR_06_10/en/
6. Cook RL, Comer DM, Wiesenfeld HC, et al. Alcohol and drug use and related disorders: An underrecognized health issue among adolescents and young adults attending sexually transmitted disease clinics. Sex Transm Dis 2006;33:565–570. [PubMed: 16572042]
7. Howards PP, Thomas JC, Earp JA. Do clinic-based STD data reflect community patterns? Int J STD AIDS 2002;13:775–780. [PubMed: 12437899]

8. Leichliter, JS.; Ellen, JM.; Gunn, RA. STD repeaters: Implications for the individual and STD transmission in a population. In: Aral, SO.; Douglas, JM.; Lipshultz, JA., editors. Behavioral interventions for prevention and control of sexually transmitted diseases. New York: Springer; 2007. p. 354-373.
9. Newman LM, Warner L, Weinstock HS. Predicting subsequent infection in patients attending sexually transmitted disease clinics. Sex Transm Dis 2006;33:737–742. [PubMed: 16708054]
10. Weinstock HS, Sidhu J, Gwinn M, Karon J, Petersen LR. Trends in HIV seroprevalence among persons attending sexually transmitted disease clinics in the United States, 1988–1992. J Acquir Immune Defic Syndr Hum Retrovirol 1995;9:514–522. [PubMed: 7627627]
11. Weinstock H, Sweeney S, Satten GA, Gwinn M. HIV seroincidence and risk factors among patients repeatedly tested for HIV attending sexually transmitted disease clinics in the United States, 1991 to 1996. STD Clinic HIV Seroincidence Study Group. J Acquir Immune Defic Syndr Hum Retrovirol 1998;19:506–512. [PubMed: 9859965]
12. DiClemente RJ, Milhausen R, Sales JM, Salazar LF, Crosby RA. A programmatic and methodologic review and synthesis of clinic-based risk-reduction interventions for sexually transmitted infections: Research and practical implications. Seminars in Pediatric Infectious Diseases 2004;16:199–218. [PubMed: 16044394]
13. Crepaz N, Horn AK, Rama SM, et al. The efficacy of behavioral interventions in reducing HIV risk sex behaviors and incident sexually transmitted disease in black and Hispanic sexually transmitted disease clinic patients in the United States: a meta-analytic review. Sex Transm Dis 2007;34:319–332. [PubMed: 17038965]
14. Ward DJ, Rowe B, Pattison H, Taylor RS, Radcliffe KW. Reducing the risk of sexually transmitted infections in genitourinary medicine clinic patients: a systematic review and meta-analysis of behavioural interventions. Sex Transm Infect 2005;81:386–393. [PubMed: 16199737]
15. Fisher JD, Fisher WA. Changing AIDS-risk behavior. Psychological Bulletin 1992;111:455–474. [PubMed: 1594721]
16. Fisher, WA.; Fisher, JD.; Harman, J.; Suls, J.; Wallston, KA. Social psychological foundations of health and illness. Malden, MA US: Blackwell Publishing; 2003. The information-motivation-behavioral skills model: A general social psychological approach to understanding and promoting health behavior; p. 82-106.
17. Kreuter MW, Wray RJ. Tailored and targeted health communication: strategies for enhancing information relevance. Am J Health Behav 2003;27(Suppl 3):S227–232. [PubMed: 14672383]
18. Jadad AR, Moore RA, Carroll D, et al. Assessing the quality of reports of randomized clinical trials: is blinding necessary? Control Clin Trials 1996;17:1–12. [PubMed: 8721797]
19. Miller, WR.; Brown, JM.; Simpson, TL., et al. Handbook of alcoholism treatment approaches: Effective alternatives. 2. Needham Heights, MA US: Allyn & Bacon; 1995. What works? A methodological analysis of the alcohol treatment outcome literature; p. 12-44.
20. Cohen, J. Statistical Power Analysis for the Behavioral Sciences. 2. New York: Erlbaum; 1988.
21. Lipsey, MW.; Wilson, DB. Practical meta-analysis. Thousand Oaks, CA: Sage; 2001.
22. Sanchez-Meca J, Marin-Martinez F, Chacon-Moscoso S. Effect-size indices for dichotomized outcomes in meta-analysis. Psychol Methods 2003;8:448–467. [PubMed: 14664682]
23. Morris SB, DeShon RP. Combining effect size estimates in meta-analysis with repeated measures and independent-groups designs. Psychol Methods 2002;7:105–125. [PubMed: 11928886]
24. Hedges LV. Distribution theory for Glass's estimator of effect size and related estimators. J Educ Stat 1981;6:107–128.
25. Johnson, BT.; Wood, T. DSTAT 2.0: Software for Meta-Analysis. 2006.
26. Emerson, JD.; Strenio, J. Boxplots and batch comparisons. In: Hoaglin, DC.; Mosteller, F.; Tukey, JW., editors. Understanding robust and exploratory data analysis. New York: Wiley; 1983. p. 58-96.
27. Hedges, LV.; Olkin, L. Statistical methods for meta-analysis. Orlando, FL: Academic Press; 1985.
28. Higgins JP, Thompson SG. Quantifying heterogeneity in a meta-analysis. Stat Med 2002;21:1539–1558. [PubMed: 12111919]
29. Huedo-Medina TB, Sanchez-Meca J, Marin-Martinez F, Botella J. Assessing heterogeneity in meta-analysis: Q statistic or I2 index? Psychol Methods 2006;11:193–206. [PubMed: 16784338]

30. Hedges, LV. Fixed effects models. In: Cooper, H.; Hedges, LV., editors. The Handbook of Research Synthesis. New York: Russell Sage Foundation; 1994. p. 285-299.

31. StataCorp. Stata. College Station, TX: StataCorp; 2007.

32. Rosenthal R. The “file-drawer” problem and tolerance for null results. Psyc Bull 1979;86:638–641.

33. Sterne JA, Egger M. Funnel plots for detecting bias in meta-analysis: guidelines on choice of axis. J Clin Epidemiol 2001;54:1046–1055. [PubMed: 11576817]

34. Begg CB, Mazumdar M. Operating characteristics of a rank correlation test for publication bias. Biometrics 1994;50:1088–1101. [PubMed: 7786990]

35. Egger M, Davey Smith G, Schneider M, Minder C. Bias in meta-analysis detected by a simple, graphical test. BMJ 1997;315:629–634. [PubMed: 9310563]

36. Greenhouse, JB.; Iyengar, S. Sensitivity analysis and diagnosis. In: Cooper, H.; Hedges, LV., editors. The Handbook of Research Synthesis. New York: Russell Sage Foundation; 1994. p. 383-398.

*37. Boyer CB, Barrett DC, Peterman TA, Bolan G. Sexually transmitted disease (STD) and HIV risk in heterosexual adults attending a public STD clinic: evaluation of a randomized controlled behavioral risk-reduction intervention trial. AIDS 1997;11:359–367. [PubMed: 9147428]

*38. Branson BM, Peterman TA, Cannon RO, Ransom R, Zaidi AA. Group counseling to prevent sexually transmitted disease and HIV: a randomized controlled trial. Sex Transm Dis 1998;25:553–560. [PubMed: 9858353]

*39. Carey MP, Senn TE, Vanable PA, Coury-Doniger P, Urban MA. Brief and intensive interventions to promote sexual risk reduction among STD clinic patients: A randomized controlled trial. AIDS & Behav. 2009

*40. Crosby RA, DiClemente R, Charnigo R, Snow G, Troutman A. Evaluation of a lay health advisor model risk-reduction intervention for promoting safer sex among heterosexual African American men newly diagnosed with an STD: A randomized controlled trial. Am J Public Health. 2008

*41. DeLamater J, Wagstaff DA, Havens KK. The impact of a culturally appropriate STD/AIDS education intervention on black male adolescents’ sexual and condom use behavior. Health Educ Behav 2000;27:454–470. [PubMed: 10929753]

*42. Gillmore MR, Morrison DM, Richey CA, et al. Effects of a skill-based intervention to encourage condom use among high risk heterosexually active adolescents. AIDS Educ Prev 1997;9:22–43. [PubMed: 9083597]

*43. Gollub EL, French P, Latka M, Rogers C, Stein Z. Achieving safer sex with choice: studying a women’s sexual risk reduction hierarchy in an STD clinic. J Womens Health Gend Based Med 2001;10:771–783. [PubMed: 11703890]

*44. Kalichman SC, Cherry C. Male polyurethane condoms do not enhance brief HIV-STD risk reduction interventions for heterosexually active men: results from a randomized test of concept. Int J STD AIDS 1999;10:548–553. [PubMed: 10471107]

*45. Kalichman SC, Cherry C, Browne-Sperling F. Effectiveness of a video-based motivational skills-building HIV risk-reduction intervention for inner-city African American men. J Consult Clin Psychol 1999;67:959–966. [PubMed: 10596517]

*46. Kalichman SC, Williams E, Nachimson D. Brief behavioural skills building intervention for female controlled methods of STD-HIV prevention: outcomes of a randomized clinical field trial. Int J STD AIDS 1999:10–174.

*47. Kalichman SC, Cain D, Weinhardt L, et al. Experimental components analysis of brief theory-based HIV/AIDS risk-reduction counseling for sexually transmitted infection patients. Health Psychol 2005:24–198.

*48. Kamb ML, Fishbein M, Douglas JM Jr, et al. Efficacy of risk-reduction counseling to prevent human immunodeficiency virus and sexually transmitted diseases: A randomized controlled trial. Project RESPECT Study Group. JAMA 1998:280–1161.

*49. Kissinger P, Mohammed H, Richardson-Alston G, et al. Patient-delivered partner treatment for male urethritis: a randomized, controlled trial. Clin Infect Dis 2005:41–623.

*50. Metcalf CA, Douglas JM Jr, Malotte CK, et al. Relative efficacy of prevention counseling with rapid and standard HIV testing: a randomized, controlled trial (RESPECT-2). Sex Transm Dis 2005:32–130.

*51. Metzler CW, Biglan A, Noell J, Ary DV, Ochs L. A randomized controlled trial of a behavioral intervention to reduce high-risk sexual behavior among adolescents in STD clinics. Behav Ther 2000:31–27.

*52. The National Institute of Mental Health (NIMH) Multisite HIV Prevention Trial Group. NIMH> The NIMH Multisite HIV Prevention Trial: reducing HIV sexual risk behavior. Science 1998:280–1889.

*53. O'Leary A, Ambrose TK, Raffaelli M, et al. Effects of an HIV risk reduction project on sexual risk behavior of low-income STD patients. AIDS Educ Prev 1998:10–483.

*54. Orr DP, Langefeld CD, Katz BP, Caine VA. Behavioral intervention to increase condom use among high-risk female adolescents. J Pediatr 1996:128–288.

*55. Shain RN, Piper JM, Newton ER, et al. A randomized, controlled trial of a behavioral intervention to prevent sexually transmitted disease among minority women. N Engl J Med 1999:340–93.

*56. Wenger NS, Linn LS, Epstein M, Shapiro MF. Reduction of high-risk sexual behavior among heterosexuals undergoing HIV antibody testing: a randomized clinical trial. Am J Public Health 1991:81–1580.

*57. Artz L, Macaluso M, Meinzen-Derr J, et al. A randomized trial of clinician-delivered interventions promoting barrier contraception for sexually transmitted disease prevention. Sex Transm Dis 2005:32–672.

*58. Shain RN, Piper JM, Holden AE, et al. Prevention of gonorrhea and Chlamydia through behavioral intervention: results of a two-year controlled randomized trial in minority women. Sex Transm Dis 2004:31–401.

*59. Cohen DA, Dent C, MacKinnon D. Condom skills education and sexually transmitted disease reinfection. Journal of Sex Research 1991:28–139.

*60. Cohen DA, Dent C, MacKinnon D, Hahn G. Condoms for men, not women. Results of brief promotion programs. Sex Transm Dis 1992:19–245.

*61. Cohen DA, MacKinnon DP, Dent C, Mason HR, Sullivan E. Group counseling at STD clinics to promote use of condoms. Public Health Rep 1992:107–727.

*62. Gollub EL, French P, Loundou A, et al. A randomized trial of hierarchical counseling in a short, clinic-based intervention to reduce the risk of sexually transmitted diseases in women. AIDS 2000:14–1249.

*63. Maher JE, Peterman TA, Osewe PL, Odusanya S, Scerba JR. Evaluation of a community-based organization's intervention to reduce the incidence of sexually transmitted diseases: a randomized, controlled trial. South Med J 2003:96–248.

*64. O'Donnell LN, Doval AS, Duran R, O'Donnell C. Video-based sexually transmitted disease patient education: its impact on condom acquisition. Am J Public Health 1995:85–817.

*65. Smith PB, Weinman ML, Parrilli J. The role of condom motivation education in the reduction of new and reinfection rates of sexually transmitted diseases among inner-city female adolescents. Patient Educ Couns 1997:31–77.

*66. Warner L, Klausner JD, Rietmeijer CA, et al. Effect of a brief video intervention on incident infection among patients attending sexually transmitted disease clinics. PLoS Med 2008;5:e135. [PubMed: 18578564]

*67. Carey MP, Coury-Doniger P, Senn TE, Vanable PA, Urban MA. Improving HIV rapid testing rates among STD clinic patients: a randomized controlled trial. Health Psychol 2008:27–833.

68. Grissom RJ. The magical number .7 +/− .2: meta-meta-analysis of the probability of superior outcome in comparisons involving therapy, placebo, and control. J Consult Clin Psychol 1996;64:973–982. [PubMed: 8916626]

69. Neumann MS, Johnson WD, Semaan S, et al. Review and meta-analysis of HIV prevention intervention research for heterosexual adult populations in the United States. J Acquir Immune Defic Syndr 2002;30(Suppl 1):S106–117. [PubMed: 12107364]

70. Hall HI, Song R, Rhodes P, et al. Estimation of HIV incidence in the United States. JAMA 2008;300:520–529. [PubMed: 18677024]

71. Krosnick JA, Alwin DF. Aging and susceptibility to attitude change. Journal of Personality and Social Psychology 1989;57:416–425. [PubMed: 2778632]

72. Visser PS, Krosnick JA. Development of attitude strength over the life cycle: Surge and decline. Journal of Personality and Social Psychology 1998;75:1389–1410. [PubMed: 9914661]

73. Amaro H. Love, sex, and power. Considering women's realities in HIV prevention. Am Psychol 1995;50:437–447. [PubMed: 7598292]

74. Pearson J. Personal control, self-efficacy in sexual negotiation, and contraceptive risk among adolescents: The role of gender. Sex Roles 2006;54:615–625.

75. Kershaw TS, Ickovics JR, Lewis JB, et al. Sexual risk following a sexually transmitted disease diagnosis: the more things change the more they stay the same. J Behav Med 2004;27:445–461. [PubMed: 15675634]

76. Wilson TE, Jaccard J, Levinson RA, Minkoff H, Endias R. Testing for HIV and other sexually transmitted diseases: implications for risk behavior in women. Health Psychol 1996;15:252–260. [PubMed: 8818671]

77. Prochaska JO, DiClemente CC. Transtheoretical therapy: Toward a more integrative model of change. Psychother Theor Res 1982;19:276–288.

78. Lyles CM, Kay LS, Crepaz N, et al. Best-evidence interventions: findings from a systematic review of HIV behavioral interventions for US populations at high risk, 2000–2004. Am J Public Health 2007;97:133–143. [PubMed: 17138920]

79. Fisher, JD.; Fisher, WA.; Shuper, PA. The information-motivation-behavioral skills model of HIV preventive behavior. In: DiClemente, RJ.; Crosby, RA.; Kegler, MC., editors. Emerging theories in health promotion practice and research. San Francisco, CA: Jossey-Bass; 2009.

80. Johnson BT, Scott-Sheldon LA, Carey MP. Meta-Synthesis of Health Behavior Change Meta-Analyses. Am J Public Health.

81. Schroder KE, Carey MP, Vanable PA. Methodological challenges in research on sexual risk behavior: II. Accuracy of self-reports. Ann Behav Med 2003;26:104–123. [PubMed: 14534028]

82. Weinhardt LS, Forsyth AD, Carey MP, Jaworski BC, Durant LE. Reliability and validity of self-report measures of HIV-related sexual behavior: progress since 1990 and recommendations for research and practice. Arch Sex Behav 1998;27:155–180. [PubMed: 9562899]

†83. Artz L, Macaluso M, Kelaghan J, et al. An intervention to promote the female condom to sexually transmitted disease clinic patients. Behav Modif 2005:29–318.

†84. Legardy JK, Macaluso M, Artz L, Brill I. Do participant characteristics influence the effectiveness of behavioral interventions? Promoting condom use to women. Sex Transm Dis 2005:32–665.

†85. Jenkins PR, Jenkins RA, Nannis ED, McKee KT Jr, Temoshok LR. Reducing risk of sexually transmitted disease (STD) and human immunodeficiency virus infection in a military STD clinic: evaluation of a randomized preventive intervention trial. Clin Infect Dis 2000:30–730.

†86. McKee KT Jr, Jenkins PR, Garner R, et al. Features of urethritis in a cohort of male soldiers. Clin Infect Dis 2000:30–736.

†87. Kamb ML, Dillon BA, Fishbein M, Willis KL. Quality assurance of HIV prevention counseling in a multi-center randomized controlled trial. Project RESPECT Study Group. Public Health Rep 1996;111(Suppl 1):99–107. [PubMed: 8862164]

†88. Metcalf CA, Malotte CK, Douglas JM Jr, et al. Efficacy of a booster counseling session 6 months after HIV testing and counseling: a randomized, controlled trial (RESPECT-2). Sex Transm Dis 2005:32–123.

†89. O'Donnell L, San Doval A, Duran R, O'Donnell CR. The effectiveness of video-based interventions in promoting condom acquisition among STD clinic patients. Sex Transm Dis 1995:22–97.

†90. O'Donnell CR, O'Donnell L, San Doval A, Duran R, Labes K. Reductions in STD infections subsequent to an STD clinic visit. Using video-based patient education to supplement provider interactions. Sex Transm Dis 1998:25–161.

†91. O'Donnell L, San Doval A, Vornfett R, O'Donnell CR. STD prevention and the challenge of gender and cultural diversity: knowledge, attitudes, and risk behaviors among black and Hispanic inner-city STD clinic patients. Sex Transm Dis 1994:21–137.

†92. O'Leary A, Maibach E, Ambrose TK, Jemmott JB 3rd, Celentano D. Social cognitive predictors of sexual risk behavior change among STD clinic patients. AIDS Behav 2000:4–309.

†93. Thurman AR, Holden AE, Shain RN, Perdue S, Piper JM. Preventing recurrent sexually transmitted diseases in minority adolescents: a randomized controlled trial. Obstet Gynecol 2008:111–1417.

†94. Shain RN, Perdue ST, Piper JM, et al. Behaviors changed by intervention are associated with reduced STD recurrence: the importance of context in measurement. Sex Transm Dis 2002:29–520.

†95. Myint UA, Bull S, Greenwood GL, et al. Safe in the City: Developing an Effective Video-Based Intervention for STD Clinic Waiting Rooms. Health Promot Pract. 2008

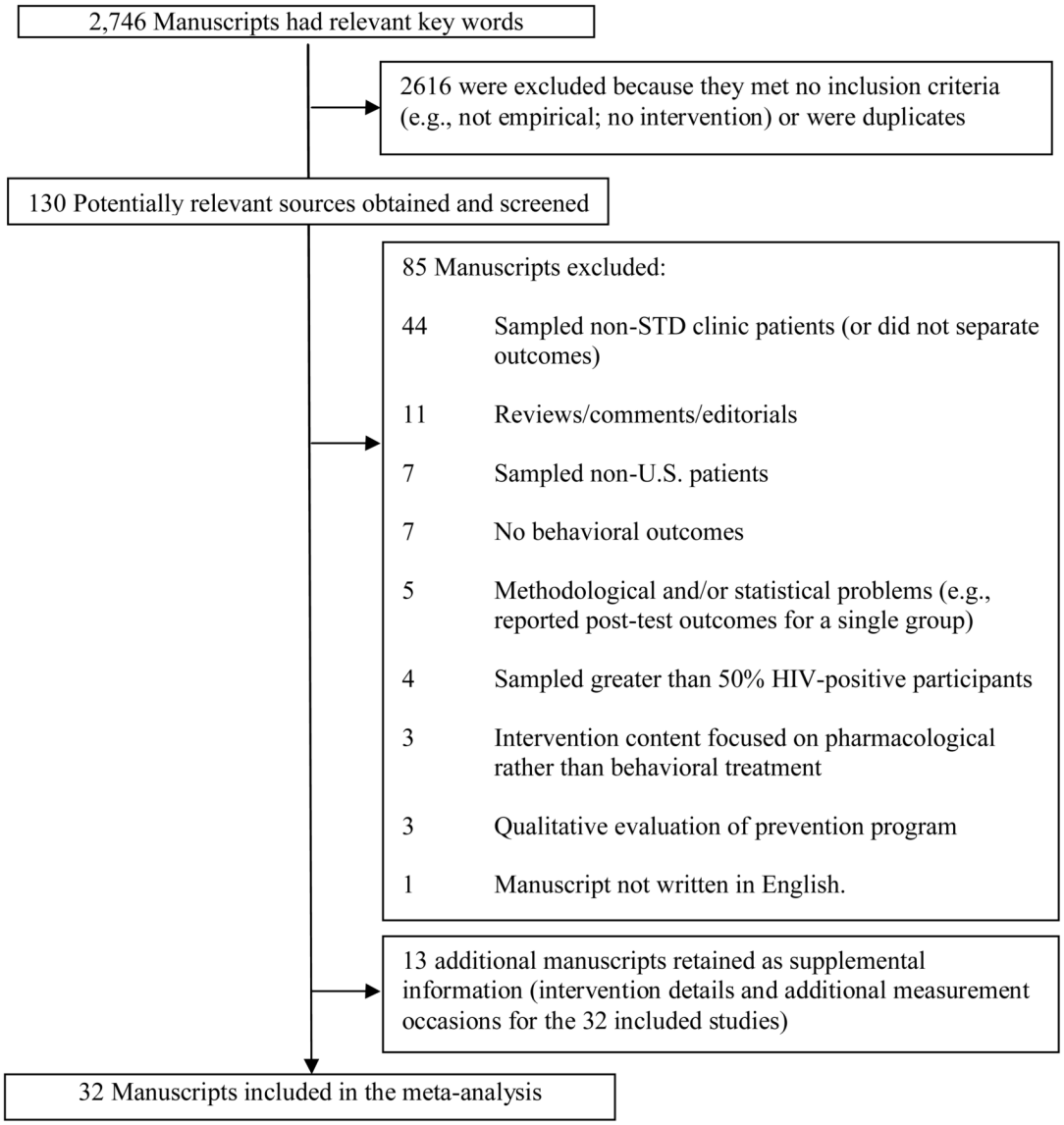

Figure 1.
Selection process for study inclusion in the meta-analysis

Table 1

Study, Sample, and Intervention Characteristics of the 32 Studies Included in the Meta-Analysis

		Intervention Details							
Study	**Sample**	**Location**	**Control**	**Delivery**	**Facilitators**	**Sessions**	**Dose[a]**	**Incentive**	**MQ**
Artz et al. (57,83,84)	*N* = 427 (16%); 100% F; 88% B; *M* age = 25; 48% STD	Birmingham, AL	INFO	Video + Individual	1 Para	1	49	NR	11
Boyer et al. (37)	*N* = 395 (28%); 33% F; 46% B	San Francisco, CA	SC	Individual	1 Para	4	240	Assessments (US $20–30)	11
Branson et al. (38)	*N* = 964 (46%); 44% F; 90% B; 50% STD	Houston, TX	SC	Group	1	4	240	Attendance (US $15 per session)	10
Carey et al. (67)	*N* = 60 (0%); 17% F; 67% B; 17% *M* age = 31.3; STD	Rochester, NY	SC	Individual	1 Para	1	17.5	Assessment (US $20)	11.3
Carey et al. (39)	*N* = 1497 (26%); 46% F; 64% B; 18% STD	Rochester, NY	INFO	Individual + Group	1.5 Para/Prof	2	255	Assessments (US $20–30);	12
				Individual + Group	1.5 Para/Prof	2	255	Attendance (US $40); child care, lunch	
				Individual + Group	1 Para/Prof	2	255		
				Individual + Group	1.5 Para/Prof	2	255		
				Individual	1 Para	1	15	Assessments (US $20–30)	
Cohen et al. (59)	*N* =192 (0%); 41% F; 67% B; 88% STD	Los Angeles, CA	AO	Group	1 Para	1	12.5	NR	10.2
Cohen et al. (60)	*N* = 903 (0%); 39% F; 72% B; 88% STD	Los Angeles, CA	AO	Group	1 Para	1	17.5	Assessment (US $5)	10
				Group	1 Para		17.5		
				Group	1 Para	1	17.5		
Cohen et al. (61)	*N* = 551 (33%); 29% F; 92% B; *M* age = 28.4; 100% STD	Los Angeles, CA	AO	Group	1 Para	1	45	NR	9
Crosby et al. (40)	*N* = 266 (26%); 0% F; 100% B; *M* age = 23.3; 100% STD	Southern US city	SC	Individual	1 Para	1	47.5	Assessments (US $40–60)	12
DeLamater et al. (41)	*N* = 562 (1%); 0% F; 100% B; *M* age = 18.3	Milwaukee, WI	SC	Video	NR	1	14	Assessment (US $10–20)	11
				Individual	1 Para	1	14		
Gillmore et al. (42)	*N* = 226 (36%); 58% F; 54% W; *M* age = 17.11	Northwestern US	RCNM	Video + Comic Book	NR	1	43	Assessments (US $10–40); gift bag	7
Gollub et al. (62)	*N* = 1591 (0%); 100% F; 91% B; *M* age = 27.75; 60% STD	Philadelphia, PA	RCM	Group	1 Para	1	22.5	NR	11
Gollub et al. (43)	*N* = 292 (38%); 100% F; 91% B; *M* age = 27.9	Philadelphia, PA	RCM	Group	1 Para	1	21.5	NR	7

			Intervention Details						
Study	**Sample**	**Location**	**Control**	**Delivery**	**Facilitators**	**Sessions**	**Dose[a]**	**Incentive**	**MQ**
Jenkins et al. (85,86)	*N* = 400 (27%); 0% F; 57% B; 69% STD	Fort Bragg, NC	SC	Individual	1 Para/Prof	2	35	NR	9
				Individual + Video	1 Para/Prof	2	35		
				Individual	1 Para/Prof	2	35		
Kalichman et al. (47)	*N* = 752 (35%); 31% F; 95% B; *M* age = 35.3	Milwaukee, WI	INFO	Individual	1 Para	1	90	Assessments (US $35–45)	13
				Individual	1 Para	1	90		
				Individual	1 Para	1	90		
Kalichman et al. (44)	*N* = 108 (11%); 0% F; 100% B; *M* age = 33.8	Southeastern US	RCM	Group	2 Para	1	180	Assessments (US $30–35); snacks, lunch	11
				Group	2 Para	1	180		
Kalichman et al. (45)	*N* = 117 (18%); 0% F; 100% B; *M* age = 33.3	Atlanta, GA	RCM	Group	2 Para	2	360	Assessments (US $25–35); snacks, lunch	11
Kalichman et al. (46)	*N* = 81 (6%); 100% F; 100% B; *M* age = 31.5	Atlanta, GA	ICM	Groups	2 Para	1	150	Assessments (US $30–35); snacks, lunch	9
Kamb et al. (48,87)	*N* = 5708 (46%); 43% F; 59% B; 32% STD	Multiple U.S. cities	INFO	Individual	1 Para	4	200	Assessments (US $15–25);	13
				Individual	1 Para	2	40	Attendance (US $15)	
Kissinger et al. (49)	*N* = 977 (21%); 0% F; 96% B; 100% STD	New Orleans, LA	RCM	Individual	1 Para	1	15	Assessments (US $10–40)	8.5
				Individual	1 Para	1	15		
Maher et al. (63)	*N* = 581 (60%); 0% F; 100% B; *M* age = 23.6; 36.3% STD	Dade County, FL	SC	Individual	1 Para	3	152.5	Attendance ($15)	9
Metcalf et al. (50,88)	*N* = 3297 (13%); 45% F; 51% B; *M* age = 25.6; 25.4% STD	Multiple U.S. cities	RCNM	Individual	1 Para	2	40	Assessments (US $25–50)	14.5
Metzler et al. (51)	*N* = 339 (56%); 68% F; 68% W; *M* age = 17.3; 100% STD	Oregon	SC	Individual	1 Para	3.7	277.5	Assessments (US $10–50); Assessments (US $5–20	12
NIMH (52)	*N* = 2426 (21%); 36% F; 74% B; 100% STD	Multiple U.S. cities	INFO	Group	2 Para	7	735	Assessments (US $5–40); Attendance (US $10–20); Bonus (US $1–10)	15
O'Donnell et al. (64,89–91)	*N* = 3348 (3%); 40% F; 62% B; *M* age = 29.8; 54% STD	South Bronx, NY	AO	Video	NR	1	20	NR	7
				Video + Group	1 Para	1	40		
O'Leary et al. (53,92)	*N* = 659 (28%); 41% F; 91% B; *M* age = 30.1	Maryland, Georgia, and New Jersey	SC/ICM	Group	2 Para/Prof	7	630	NR	10
Orr et al. (54)	*N* = 209 (46%); 100% F; 55% B; *M* age = 17.9; 100% STD	Indiana	INFO	Individual	1 Para	1	15	Free treatment medication	10.6

				Intervention Details					
Study	**Sample**	**Location**	**Control**	**Delivery**	**Facilitators**	**Sessions**	**Dose[a]**	**Incentive**	**MQ**
Shain et al.(55,93,94)	*N* = 739 (26%); 100% F; 69% B; *M* age = 21.6; 100% STD	San Antonio, TX	SC	Individual	1 Para	3	630	Assessments (US $25–50); Attendance (US $15–25); meals, gifts	10
Shain et al. (58)	*N* = 775 (9%); 100% F; 75% B; *M* age = 20.93; 100% STD	San Antonio, TX	SC	Group	1 Para	5.12	658.3	Assessments (US $15–50);	12
				Group	1 Para	4	557.5	Attendance (US $5–25); meals, gifts	
Smith et al. (65)	*N* = 205 (70%); 100% F; 73% B	Houston, TX	SC	Group	1 Para	1	37.5	NR	8
Warner et al. (66,95)	*N* = 38,635 (0%); 30% F; 46% W; 16% STD	Multiple U.S. cities	AO	Individual	NR	1	23	NR	12.5
Wenger et al. (56)	*N* = 256 (27%); 33% F; 88% B; *M* age = 27	Los Angeles, CA	RCNM	Group	1 Prof	2	50	NR	9

Note. N, number of consenting participants (attrition); F, proportion female; W, proportion White; B, proportion Black; AO, assessment only control; SC, standard STD or HIV counseling; INFO, information-only; RCM, relevant content, time matched; RCNM, relevant content, not time matched; ICM, irrelevant content, time matched; Para, paraprofessionals; Prof, professionals; NR, none/not reported; MQ, methodological quality score.

[a]Estimated number of minutes of intervention content excluding measurement.

Table 2

Weighted mean effect sizes and homogeneity statistics for sexual risk reduction outcomes by assessment interval

		d_+ (95% CI)		Homogeneity		
Outcome[a]	***k***	**Fixed effects**	**Random effects**	***Q***	***p***	**I^2 index (95% CI)**
Short-Term Assessment (4 to 13 weeks)						
Condom use, overall	31	**0.10 (0.07, 0.14)**	**0.09 (0.03, 0.15)**	73.57	<.001	59% (39, 73)
No. of Sexual Partners	24	**0.09 (0.06, 0.13)**	**0.08 (0.04, 0.12)**	28.17	.21	0
Incident STDs	8	0.01 (−0.06, 0.08)	−0.08 (−0.42, 0.27)	166.14	<.001	96% (94, 97)
Intermediate Assessment (22 to 39 weeks)						
Condom use, overall	26	**0.05 (0.02, 0.09)**	**0.05 (0.01, 0.10)**	38.68	.04	0
No. of Sexual Partners	22	**0.06 (0.03, 0.09)**	0.05 (−0.01, 0.10)	33.87	.04	0
Incident STDs	21	**0.13 (0.08, 0.18)**	**0.11 (0.01, 0.21)**	79.98	<.001	75% (62, 84)
Long-Term Assessment (≥52 weeks)						
Condom use, overall	13	0.03 (−0.00, 0.06)	0.04 (−0.03, 0.10)	33.44	<.001	64% (35, 80)
No. of Sexual Partners	11	**0.06 (0.01, 0.11)**	0.09 (−0.01, 0.18)	31.92	<.001	69% (41, 83)
Incident STDs	23	**0.10 (0.08, 0.12)**	**0.10 (0.05, 0.14)**	72.84	<.001	70% (54, 80)
Incident HIV	5	**0.56 (0.54, 0.58)**	**0.64 (0.29, 0.98)**	595.91	<.001	99% (99, 100)

[a]Extreme effect size values were recoded (i.e., winsorized) for condom use at short- and long-term assessment, number of sexual partners at short-term and intermediate assessments, and incident STDs at intermediate and long-term assessments. The magnitude and direction of the weighted mean effect sizes including outliers were consistent with the results excluding outliers (except for incident STDs at intermediate assessment, random effects: $d_+ = 0.10$, 95% CI = −0.01, 0.21).

Note. *k*, number of interventions. d_+, weighted mean effect size. CI, confidence interval. Boldface text indicates statistically significant improvements among treatment compared with control patients.

Table 3

Moderators of condom use, number of sexual partners, and number of incident STDs by assessment interval*

	Short-Term			Intermediate			Long-Term		
Moderators	**β**	***P***	***k***	**β**	***P***	***k***	**β**	***P***	***k***
Condom Use									
Age group	**.36**	.002	31	.25	.115	26	.05	.770	13
% Black	.00	.973	31	.11	.504	26	−.17	.312	13
% Women	−.25	.035	31	−.08	.633	26	.33	.054	13
% STD	.34	.012	22	**.68**	.002	14	**.78**	<.001	13
Motivation	−.00	.986	31	.24	.133	26	.11	.541	13
Skills	.08	.468	31	.24	.129	26	.17	.329	13
Provided condoms	**.37**	.001	31	.24	.129	26	−.15	.388	13
Tailored	−.07	.555	31	−.33	.041	26	**−.49**	.005	13
Targeted	**.36**	.002	31	.39	.014	26	**.82**	<.001	13
Total dose	.27	.022	31	.40	.012	26	**.72**	<.001	13
No. of Sexual Partners									
Age group	**.55**	.003	24	.43	.012	22	**.87**	<.001	11
% Black	−.32	.088	24	−.41	.017	22	**−.64**	<.001	11
% Women	−.07	.716	24	.20	.233	22	**.87**	<.001	11
% STD	−.26	.207	18	.37	.078	12	**.82**	<.001	11
Motivation	−.11	.574	24	.00	.977	22	−.14	.444	11
Skills	−.01	.939	24	.01	.957	22	.06	.754	11
Provided condoms	**.58**	.002	24	.28	.102	22	.	.	11
Tailored	.38	.042	24	.26	.124	22	**−.63**	<.001	11
Targeted	−.01	.978	24	−.31	.069	22	**.87**	<.001	11
Total dose	−.25	.189	24	.14	.422	22	**.78**	<.001	11
Incident STDs									
Age group	**.95**	<.001	8	.08	.477	21	**.37**	.002	23
% Black	**.74**	<.001	8	−.03	.781	21	−.03	.769	23
% Women	**−.91**	<.001	8	**−.43**	<.001	21	**.33**	.005	23

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	Short-Term			Intermediate			Long-Term		
Moderators	**β**	***P***	***k***	**β**	***P***	***k***	**β**	***P***	***k***
% STD	**.95**	<.001	8	.19	.092	19	.23	.057	22
Motivation	**−.70**	<.001	8	**.40**	<.001	21	−.12	.316	23
Skills	**−.52**	<.001	8	.07	.558	21	−.19	.107	23
Provided condoms	.	.	8	−.11	.328	21	.13	.272	23
Tailored	**−.70**	<.001	8	.20	.071	21	.06	.632	23
Targeted	.	.	8	−.13	.252	21	.14	.247	23
Total dose	**−.74**	<.001	8	.20	.071	21	.07	.526	23

*Models used the inverse of the variance for each effect size as weights; reported coefficients (β) are standardized. *k* = number of studies. Bold typeface values are significant at $P \leq .005$ level (Bonferroni adjusted *P*-value). Potential moderators with missing values indicate all observations contained identical values.