

Complex Solutions for a Complex Problem: A Meta-Analysis of the Efficacy of Multiple-  
Behavior Interventions on Change in Outcomes Related to HIV

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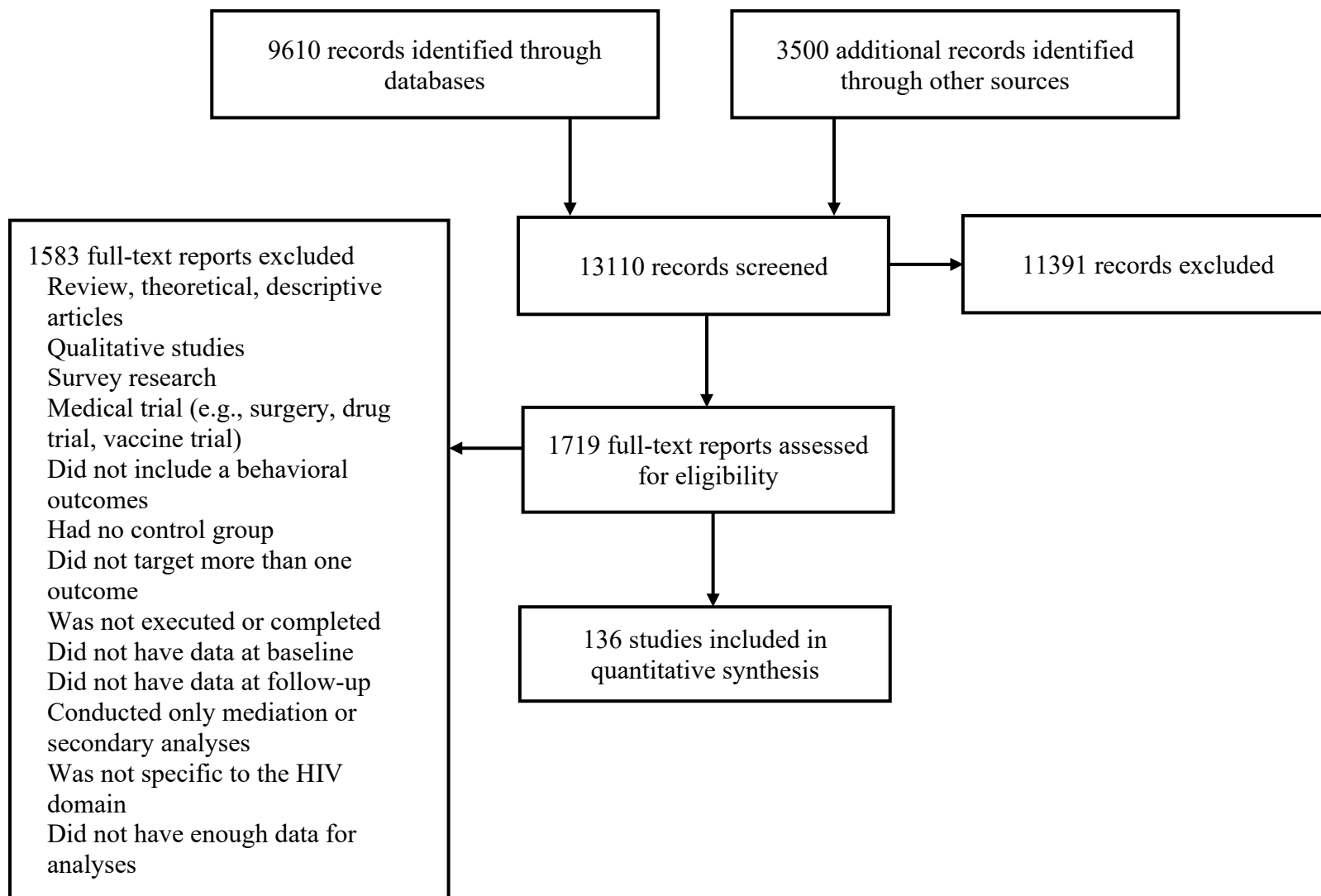
## APPENDIX A

### Keywords used in the literature search

Our search terms included: *intervention, health education, persuasion, recommendation, treatment, educational program, rehabilitation, counseling outcomes, treatment outcomes, treatment effectiveness evaluation, treatment compliance, health promotion, behavior change* and *randomized trial*. To identify interventions targeting multiple HIV-related behaviors or domains, these keywords were entered in combination with keywords, including: *HIV, AIDS, STI, condom use, circumcision, alcohol use, drug use, and adherence*.

APPENDIX B

Flow of reports included in the meta-analysis



## APPENDIX C

Reports included in the meta-analysis

<b>Author (Year)</b>	<b>Objective</b>	<b>Group<sup>a</sup></b>	<b>Number of Recommendati ons</b>	<b>Number of Main Recommend ations</b>	<b>Number of Auxiliary Recommendations</b>	<b>Sample Size</b>
Aharonovich, Stohl, Cannizzaro & Hasina (2017)	To investigate the feasibility and efficacy of reducing non-injection drug use and alcohol use with HealthCall	Multiple-behavior intervention	4	2	2	24
		Multiple-behavior intervention	5	2	3	23
Amaro et al. (2007)	To test the effectiveness of a substance abuse treatment combined with HIV/AIDS prevention on reducing sexual risk behaviors	Multiple-behavior intervention	2	2	0	161
		Multiple-behavior intervention	6	2	4	181
Amirkhanian et al. (2005)	To evaluate an HIV prevention intervention program with social networks of MSM	Single-behavior intervention	1	1	0	276
		Multiple-behavior intervention	4	2	2	133
Avants, Margolin, Usubiaga & Doebrick (2004)	To investigate the efficacy of a harm reduction group intervention for IDUs, based on the Information-Motivation-Behavioral skills model of behavior change	Multiple-behavior intervention	2	2	0	112
		Multiple-behavior intervention	7	2	5	112
Bachanas et al. (2016)	To assess the effectiveness of a multi-component, clinic-based HIV prevention intervention for HIV-positive people	Control	0	0	0	1778
		Multiple-behavior intervention	5	2	3	1744

Bahromov & Weine (2011)	To evaluate the feasibility of the Transit to Russia AIDS Intervention with Newcomers (TRAIN) prevention intervention	Control	0	0	0	30
		Multiple-behavior intervention	2	2	0	30
Bailey et al. (2007)	To determine whether male circumcision had a protective effect against HIV infection, and determine the changes in sexual behavior that may be related to this	Control	0	0	0	1393
		Single-behavior intervention	1	1	0	1391
Baird, Garfein, McIntosh & Özler (2012)	To evaluate a cash transfer program's ability to reduce the risk of STI	Control	0	0	0	1948
		Single-behavior intervention	1	1	0	1848
Barnett, Sorensen, Wong, Haug & Hall (2009)	To assess the effects of incentives to improve the HAART adherence	Single-behavior intervention	1	1	0	32
		Single-behavior intervention	1	1	0	34
Berrien, Salazar, Reynolds & McKay (2004)	To determine if a home-based nursing intervention can improve medication adherence	Multiple-behavior intervention	2	2	0	15
		Multiple-behavior intervention	3	2	1	19
Borawski, Trapl, Lovegreen, Colabianchi & Block (2005)	To assess the effectiveness of an abstinence-until-marriage curriculum	Control	0	0	0	973
		Single-behavior intervention	1	1	0	1096
Boyer et al. (2005)	To evaluate the use of a cognitive-behavioral	Multiple-behavior intervention	2	2	0	1062

	intervention on the prevention of STIs and unintended pregnancies	Multiple-behavior intervention	3	2	1	1095
Boyer, Shafer & Tschann (1997)	To assess the efficacy of a school-based knowledge-building and cognitive-behavioral skills-building STI/HIV prevention intervention program	Multiple-behavior intervention	2	2	0	303
		Multiple-behavior intervention	8	2	6	210
Cade et al. (2010)	To evaluate whether a yoga lifestyle intervention improves CVD risk factors, virologic or immunologic status, or quality of life in HIV-infected adults	Control	0	0	0	26
		Single-behavior intervention	1	1	0	34
Calsyn et al. (2010)	To determine the effectiveness of the Real Men Are Safe intervention in reducing sex under the influence of drugs or alcohol for people in substance use treatment	Single-behavior intervention	1	1	0	179
		Multiple-behavior intervention	2	2	0	177
Calsyn et al. (2009)	To determine the effectiveness of a motivational and skills training HIV/AIDS group intervention program	Single-behavior intervention	1	1	0	291
		Multiple-behavior intervention	5	2	3	282
Carrico et al. (2006)	To examine the efficacy of an intervention, combining a cognitive behavioral stress management intervention with a medication adherence training program	Single-behavior intervention	1	1	0	76
		Multiple-behavior intervention	2	2	0	54

Carrico et al. (2015)	To test the feasibility of a 5-session, positive affect intervention for methamphetamine-using men who have sex with men	Multiple-behavior intervention	3	2	1	9
		Multiple-behavior intervention	5	2	3	12
Chernoff & Davison (2005)	To evaluate a self-administered intervention to increase HIV/AIDS risk reduction	Control	0	0	0	77
		Multiple-behavior intervention	4	2	2	78
Chiou et al. (2006)	To evaluate the effect of a symptom management program on drug adherence and quality of life in people with HIV/AIDS	Control	0	0	0	22
		Multiple-behavior intervention	9	2	7	22
		Multiple-behavior intervention	10	2	8	23
Cianelli, Ferrer, Norr, Irarrazabal & Bernales (2012)	To determine the use of a peer group intervention for HIV prevention	Control	0	0	0	218
		Multiple-behavior intervention	2	2	0	182
Cornman, Schmiede, Bryan, Benziger & Fisher (2007)	To evaluate an intervention based on the Information-Motivation-Behavioral Skills model	Control	0	0	0	125
		Single-behavior intervention	1	1	0	125
Creswell, Myers, Cole & Irwin (2009)	To evaluate the efficacy of a mindfulness-based stress reduction meditation program	Control	0	0	0	26
		Single-behavior intervention	1	1	0	41
da Costa et al. (2012)	To see if an SMS-based warning system increases medication adherence	Control	0	0	0	15
		Single-behavior intervention	1	1	0	14
		Control	0	0	0	170



da Silveira & dos Santos (2006)	To test an intervention aimed at increasing condom use by partners	Single-behavior intervention	1	1	0	170
DiClemente et al. (2004)	To determine the efficacy of an intervention to reduce HIV/STI sexual risk	Multiple-behavior intervention	2	2	0	271
		Multiple-behavior intervention	8	2	6	251
Dilley et al. (2002)	To assess whether one counseling intervention session focusing on self-justifications can reduce future high-risk behaviors among HIV-negative men	Multiple-behavior intervention	2	2	0	62
		Multiple-behavior intervention	2	2	0	62
		Multiple-behavior intervention	2	2	0	62
		Multiple-behavior intervention	2	2	0	62
Donenberg, Emerson & Kendall (2018)	To investigate the efficacy of PHAT Life, a sexual risk reduction program, for youth on probation	Control	0	0	0	147
		Multiple-behavior intervention	3	2	1	163
Dushay, Singer, Weeks, Rohena & Gruber (2001)	To assess the efficacy of a culturally targeted intervention in lowering HIV risk	Multiple-behavior intervention	5	2	3	86
		Multiple-behavior intervention	5	2	3	453
Eaton et al. (2018)	To investigate a sexual risk reduction intervention for STI prevention among men who have sex with men	Multiple-behavior intervention	3	2	1	300
		Multiple-behavior intervention	7	2	5	297
El-Bassel et al. (2003)	To examine a relation-based HIV/STI prevention program	Multiple-behavior intervention	2	2	0	126
		Multiple-behavior intervention	3	2	1	162

		Multiple-behavior intervention	2	2	0	146
Feaster et al. (2010)	To test the efficacy of the Structural Ecosystems Therapy (SET), relative to a psychoeducational health group program	Multiple-behavior intervention	2	2	0	67
		Multiple-behavior intervention	6	2	4	59
Fogel et al. (2015)	To test an evidence-based HIV/STI behavioral intervention, Providing Opportunities for Women's Empowerment, Risk-Reduction and Relationships (POWER)	Multiple-behavior intervention	2	2	0	256
		Multiple-behavior intervention	7	2	5	265
Galárraga et al. (2018)	To measure the efficacy of an intervention, grounded in behavioral economics, on increased dual protection use and protection against HIV, STIs, and unintended pregnancies	Control	0	0	0	50
		Multiple-behavior intervention	2	2	0	50
Gao & Wang (2007)	To examine the use of a culturally appropriate participatory communication and HIV/AIDS prevention program in MSM	Control	0	0	0	80
		Multiple-behavior intervention	3	2	1	80
Garcia et al. (2012)	To see the effect of a multicomponent intervention on the prevention of STIs	Control	0	0	0	8816
		Multiple-behavior intervention	2	2	0	8657
Glasman et al. (2015)	To determine whether assessments of risk behaviors change behaviors, and intervention efficacy	Single-behavior intervention	1	1	0	611
		Multiple-behavior intervention	3	2	1	546

Go et al. (2015)	To test the efficacy of a multi-level intervention to reduce injection and sexual risk behaviors	Multiple-behavior intervention	2	2	0	89
		Multiple-behavior intervention	2	2	0	95
		Multiple-behavior intervention	5	2	3	139
		Multiple-behavior intervention	5	2	3	132
Goggin et al. (2013)	To determine the efficacy of a motivational interviewing-based cognitive behavioral therapy adherence counseling combined with directly observed therapy	Single-behavior intervention	1	1	0	65
		Multiple-behavior intervention	4	2	2	70
		Multiple-behavior intervention	4	2	2	69
Grimley & Hook (2009)	To investigate the efficacy of a brief theory-based behavioral intervention	Multiple-behavior intervention	2	2	0	227
		Multiple-behavior intervention	2	2	0	203
Gwadz et al. (2011)	To examine a peer-driven intervention and its ability to increase screening rates for AIDS clinical trials	Single-behavior intervention	1	1	0	127
		Multiple-behavior intervention	3	2	1	215
Hadley et al. (2016)	To test an interactive DVD and workbook, designed for African-American parents and adolescents, to address key factors associated with risk	Control	0	0	0	87
		Multiple-behavior intervention	4	2	2	83
Hallfors et al. (2011)	To assess whether the presence of support can keep orphans in school and reduce HIV risk	Control	0	0	0	145
		Multiple-behavior intervention	3	2	1	184

Hanson, Alessi & Petri (2008)	To test if contingency management is efficacious at reducing HIV risk behaviors	Multiple-behavior intervention	5	2	3	65
		Multiple-behavior intervention	5	2	3	100
Harrison, Pals, Sajak, Chase & Kajese (2010)	To evaluate an intervention that improves risk factor reporting	Single-behavior intervention	1	1	0	407
		Single-behavior intervention	1	1	0	466
Harvey et al. (2004)	To see whether a couple-based risk reduction intervention is effective	Single-behavior intervention	1	1	0	104
		Multiple-behavior intervention	5	2	3	110
Hershberger, Wood & Fisher (2003)	To assess the efficacy of a cognitive-behavior intervention to reduce HIV risk behaviors	Multiple-behavior intervention	2	2	0	614
		Multiple-behavior intervention	2	2	0	225
Hoffman, Exner, Leu, Ehrhardt & Stein (2003)	To evaluate female condom use among women participating in a HIV/STI intervention designed to reduce risky sexual behaviors	Control	0	0	0	120
		Multiple-behavior intervention	2	2	0	128
		Multiple-behavior intervention	2	2	0	112
Hoke et al. (2007)	To see whether individual clinic-based counselling as a supplement to peer education leads to reductions in sexual risk behaviors	Multiple-behavior intervention	2	2	0	439
		Multiple-behavior intervention	5	2	3	445
Holzemer et al. (2006)	To determine whether a nurse-delivered, tailored intervention improved adherence to HIV medications	Multiple-behavior intervention	4	2	2	122
		Control	0	0	0	118

Huber et al. (2012)	To assess the effect of smoking cessation counseling on HIV-positive people	Multiple-behavior intervention	2	2	0	2511
Ingersoll et al. (2011)	To assess the feasibility of two interventions to improve adherence and reduce problems associated with crack cocaine use	Multiple-behavior intervention	5	2	3	28
		Multiple-behavior intervention	6	2	4	28
Jemmott, Jemmott & O'Leary (2007)	To see whether brief HIV/STD risk-reduction interventions are efficacious for African American women	Control	0	0	0	118
		Multiple-behavior intervention	2	2	0	118
		Multiple-behavior intervention	4	2	2	118
		Multiple-behavior intervention	4	2	2	123
		Multiple-behavior intervention	5	2	3	81
Jemmott, Jemmott, Fong & Morales (2010)	To examine the effectiveness of an HIV/STD risk-reduction intervention for adolescents	Multiple-behavior intervention	3	2	1	1716
		Multiple-behavior intervention	4	2	2	1729
Johnson, Dilworth, Taylor & Neilands (2011)	To investigate whether improvements in coping skill of treatment side-effects can reduce nonadherence	Control	0	0	0	121
		Multiple-behavior intervention	5	2	3	128
Jones et al. (2003)	To examine the effects of a cognitive-behavioral intervention on adherence	Multiple-behavior intervention	3	2	1	92
		Multiple-behavior intervention	3	2	1	82

Juzang, Fortune, Black, Wright & Bull (2011)	To explore the feasibility of using mobile phones for HIV prevention	Single-behavior intervention	1	1	0	30
		Multiple-behavior intervention	2	2	0	30
Kalichman et al. (2014)	To test an individual- and sociostructural-level HIV prevention intervention for men who drink	Single-behavior intervention	1	1	0	487
		Multiple-behavior intervention	9	2	7	497
Kalichman et al. (2008)	To determine the efficacy of a brief HIV/alcohol risk-reduction intervention	Multiple-behavior intervention	2	2	0	183
		Multiple-behavior intervention	2	2	0	170
Kalichman et al. (2009)	To see whether an integrated intervention targeting both gender-based violence and HIV risk behaviors was effective	Multiple-behavior intervention	4	2	2	242
		Multiple-behavior intervention	4	2	2	233
Kelly et al. (1997)	To investigate a community-level intervention in lowering risk for HIV infection	Multiple-behavior intervention	3	2	1	173
		Multiple-behavior intervention	3	2	1	265
Kelly et al. (2006)	To assess the effects of an intervention for preventing HIV/STD	Single-behavior intervention	1	1	0	140
		Multiple-behavior intervention	5	2	3	145
Kerrigan et al. (2006)	To examine the effectiveness of environmental-structural interventions in reducing HIV/STI risk	Multiple-behavior intervention	2	2	0	210
		Multiple-behavior intervention	2	2	0	200
Kershaw, Magriples, Westdahl,	To explore the effects of an HIV intervention bundled	Control	0	0	0	394
		Multiple-behavior intervention	5	2	3	335

Schindler & Ickovics (2009)	with prenatal care for HIV prevention	Multiple-behavior intervention	8	2	6	318
Knudsen, Staton-Tindall, Oser, Havens & Leukefeld (2014)	To assess a prison-based intervention in reducing HIV sexual risk behaviors	Control	0	0	0	180
		Single-behavior intervention	1	1	0	198
Koblin et al. (2004)	To test the efficacy of a behavioral intervention in preventing HIV infection	Single-behavior intervention	1	1	0	2144
		Multiple-behavior intervention	4	2	2	2151
Koniak-Griffin et al. (2008)	To assess the effectiveness of a couple-focused HIV prevention program	Control	0	0	0	36
		Multiple-behavior intervention	2	2	0	30
Konkle-Parker, Erlen, Dubbert & May (2012)	To test an adherence intervention guided by the Information-Motivation-Behavioral Skills model	Control	0	0	0	28
		Multiple-behavior intervention	4	2	2	33
Landon, Wilson, Mcinnes, Landrum & Hirschhorn (2004)	To evaluate a multi-institution collaborative program to improve the quality of care for HIV patients	Control	0	0	0	1761
		Multiple-behavior intervention	3	2	1	3190
Lapinski, Randall, Peterson, Peterson & Klein (2009)	To determine the effect of a health communication intervention, Prevention Options for Positives	Multiple-behavior intervention	3	2	1	48
		Multiple-behavior intervention	3	2	1	24
		Control	0	0	0	179

Larsson, Eurenus, Westerling & Tydén (2006)	To investigate an intervention for high school students	Multiple-behavior intervention	4	2	2	282
Latkin et al. (2009)	To test the efficacy of a network intervention to promote HIV risk reduction	Multiple-behavior intervention	4	2	2	573
		Multiple-behavior intervention	4	2	2	550
Lau, Lau, Cheung & Tsui (2008)	To see how effective an internet-based intervention is at reducing HIV risk behavior	Multiple-behavior intervention	4	2	2	238
		Multiple-behavior intervention	4	2	2	237
Lau, Tsui, Cheng & Pang (2010)	To determine the efficacy of voluntary counseling + testing + information approach for promoting HIV preventive behaviors	Multiple-behavior intervention	2	2	0	154
		Multiple-behavior intervention	5	2	3	147
Lauby, Smith, Stark, Person & Adams (2000)	To test the effects of a multi-site community-level HIV prevention intervention	Control	0	0	0	951
		Multiple-behavior intervention	2	2	0	883
Lauby et al. (2010)	To investigate the efficacy of a theater-based HIV prevention intervention program	Multiple-behavior intervention	3	2	1	143
		Multiple-behavior intervention	3	2	1	146
Letourneau, McCart, Sheidow & Mauro (2017)	To evaluate a contingency management intervention addressing adolescent substance use and sexual risk behaviors	Multiple-behavior intervention	2	2	0	62
		Multiple-behavior intervention	9	2	7	45
Lewis, Rivera,	To assess the impact of an intervention to reduce	Single-behavior intervention	1	1	0	394



Crawford, Decuir & Amesty (2015)	injection drug risk among users	Multiple-behavior intervention	3	2	1	359
Lin et al. (2010)	To identify the efficacy of a motivation theory-based HIV prevention intervention	Control	0	0	0	100
		Multiple-behavior intervention	6	2	4	200
Lloyd- Richardson et al. (2009)	To test the efficacy of two smoking cessation interventions in an HIV- positive sample	Multiple-behavior intervention	2	2	0	232
		Multiple-behavior intervention	4	2	2	212
Lugada et al. (2010)	To compare HIV counseling and testing uptake among household members of patients receiving antiretroviral therapy	Multiple-behavior intervention	2	2	0	4798
		Multiple-behavior intervention	2	2	0	2386
Lutalo et al. (2010)	To assess the effects of a family planning outreach program	Control	0	0	0	3574
		Multiple-behavior intervention	2	2	0	6720
Marsch et al. (2015)	To test the comparative effectiveness of two interventions	Control	0	0	0	72
		Single-behavior intervention	1	1	0	69
Martin, O'Connell, Inciardi, Surratt & Beard (2003)	To investigate the results from a brief intervention for probationers	Multiple-behavior intervention	5	2	3	369
		Multiple-behavior intervention	5	2	3	385
Mathews et al. (2016)	To investigate the effects of a multi-component, school- based HIV prevention intervention to delay sexual debut, increase condom use,	Control	0	0	0	1703
		Multiple-behavior intervention	4	2	2	1748

	and decrease intimate partner violence among adolescents					
Mausbach, Semple, Strathdee, Zians & Patterson (2007)	To examine the efficacy of a behavioral intervention emphasizing motivational interviewing and social cognitive theory	Multiple-behavior intervention	3	2	1	150
		Multiple-behavior intervention	4	2	2	149
		Multiple-behavior intervention	4	2	2	152
McCusker et al. (1997)	To see the effects of drug treatment duration on recovery and HIV risk behavior	Multiple-behavior intervention	5	2	3	444
		Multiple-behavior intervention	7	2	5	184
McMahon, Malow, Jennings & Gomez (2001)	To evaluate the effects of a cognitive-behavioral HIV prevention intervention	Multiple-behavior intervention	3	2	1	152
		Multiple-behavior intervention	7	2	5	160
Meade et al. (2010)	To test a group coping intervention in reducing substance use	Multiple-behavior intervention	2	2	0	124
		Multiple-behavior intervention	2	2	0	123
Monti et al. (2016)	To investigate the efficacy of a single session motivational intervention for reducing heavy drinking and condomless sex in adult emergency department patients	Multiple-behavior intervention	2	2	0	188
		Multiple-behavior intervention	3	2	1	184
Moultapa, Watson, McCuller, Reiber & Tsai (2009)	To assess an intervention targeting substance use and HIV prevention	Multiple-behavior intervention	3	2	1	33
		Multiple-behavior intervention	9	2	7	33

Mugusi et al. (2009)	To evaluate various strategies aimed at improving adherence to antiretroviral therapy	Multiple-behavior intervention	5	2	3	312
		Multiple-behavior intervention	6	2	4	242
		Multiple-behavior intervention	6	2	4	67
Murphy, Chen, Naar-King & Parsons (2012)	To investigate a motivational interviewing intervention targeting multiple risk behaviors	Control	0	0	0	75
		Multiple-behavior intervention	3	2	1	68
Njuguna et al. (2016)	To test the effect of an SMS intervention on HIV testing uptake	Single-behavior intervention	1	1	0	300
		Multiple-behavior intervention	4	2	2	300
Nöstlinger et al. (2016)	To determine the efficacy of a computer-assisted intervention to improve safer sex practices	Single-behavior intervention	1	1	0	57
		Multiple-behavior intervention	5	2	3	55
Parsons, Golub, Rosof & Holder (2007)	To determine the efficacy of a behavioral intervention designed to improve adherence and reduce alcohol consumption	Multiple-behavior intervention	3	2	1	78
		Multiple-behavior intervention	9	2	7	65
Parsons, Lelutiu-Weinberger, Botsko & Golub (2014)	To test a brief motivational interviewing intervention on HIV risk and drug use	Multiple-behavior intervention	2	2	0	70
		Multiple-behavior intervention	2	2	0	73
Peltzer, Simbayi, Banyini &	To evaluate a brief HIV risk reduction counselling intervention	Multiple-behavior intervention	4	2	2	75
		Multiple-behavior intervention	4	2	2	75

Kekana (2012)						
Peragallo, Gonzalez- Guarda, McCabe & Cianelli (2012)	To assess the efficacy of an HIV risk reduction intervention	Multiple-behavior intervention	5	2	3	274
		Control	0	0	0	274
Pettifor et al. (2015)	To test a motivational interviewing-based counseling intervention for people with acute HIV infection	Multiple-behavior intervention	3	2	1	14
		Multiple-behavior intervention	4	2	2	14
Pop-Eleches et al. (2011)	To evaluate the effect of text message reminders on adherence	Control	0	0	0	139
		Single-behavior intervention	1	1	0	73
		Single-behavior intervention	1	1	0	72
		Single-behavior intervention	1	1	0	70
		Single-behavior intervention	1	1	0	74
Purcell et al. (2007)	To identify the effect of a peer-mentoring intervention for HIV-seropositive IDUs	Multiple-behavior intervention	4	2	2	480
		Multiple-behavior intervention	6	2	4	486
Reback, et al. (2010)	To evaluate contingency management among homeless men	Multiple-behavior intervention	2	2	0	67
		Multiple-behavior intervention	5	2	3	64
Rhodes et al. (2017)	To evaluate a Spanish- language, small-group HIV prevention intervention	Control	0	0	0	152
		Multiple-behavior intervention	3	2	1	152

	designed to increase condom use and HIV testing among Hispanic/Latino gay, bisexual, and other men who have sex with men					
Richardson et al. (2004)	To assess the efficacy of a brief safer-sex counseling program	Single-behavior intervention	1	1	0	172
		Single-behavior intervention	1	1	0	210
		Multiple-behavior intervention	3	2	1	190
Robles et al. (2004)	To examine the effectiveness of a combined counseling and case management behavioral intervention in reducing HIV risk behaviors among Hispanic injection drug users	Multiple-behavior intervention	7	2	5	293
		Multiple-behavior intervention	11	2	9	285
Rongkavilit et al. (2013)	To demonstrate the effect of motivational interviewing	Multiple-behavior intervention	4	2	2	53
		Multiple-behavior intervention	4	2	2	55
Rotheram-Borus, Li, Liang, Wen & Wu (2011)	To assess the effects of a community population opinion leader intervention	Multiple-behavior intervention	4	2	2	1956
		Multiple-behavior intervention	7	2	5	1956
Rotheram-Borus, Murphy, Fernandez & Srinivasan (1998)	To investigate a brief HIV intervention	Single-behavior intervention	1	1	0	75
		Multiple-behavior intervention	5	2	3	64

Roux et al. (2015)	To determine the efficacy of an educational intervention on drug use risk	Multiple-behavior intervention	2	2	0	127
		Control	0	0	0	113
Rowe et al. (2016)	To assess a family-based HIV/STI prevention approach	Multiple-behavior intervention	5	2	3	78
		Multiple-behavior intervention	8	2	6	76
Sales, Lang, Hardin, Diclemente & Wingood (2010)	To test the efficacy of an HIV prevention intervention	Multiple-behavior intervention	2	2	0	119
		Multiple-behavior intervention	8	2	6	126
Samet et al. (2008)	To demonstrate the effectiveness of a sexual risk reduction intervention	Multiple-behavior intervention	4	2	2	87
		Control	0	0	0	94
Samet et al. (2015)	To assess the efficacy of an HIV prevention intervention in decreasing STIs	Multiple-behavior intervention	3	2	1	350
		Multiple-behavior intervention	7	2	5	350
Santos et al. (2014)	To evaluate an adapted brief counseling intervention designed to reduce HIV risk behavior at its ability to also reduce substance use	Control	0	0	0	164
		Multiple-behavior intervention	2	2	0	162
Sellers, McGraw & McKinlay (1994)	To test whether the distribution of condoms increases teen sexual activity	Multiple-behavior intervention	2	2	0	293
		Control	0	0	0	293
Sorensen et al. (2007)	To evaluate a contingency management intervention designed to improve adherence	Multiple-behavior intervention	6	2	4	33
		Multiple-behavior intervention	6	2	4	33

St. Lawrence et al. (1997)	To compare an intervention based on social cognitive theory with one based on the theory of gender and power	Multiple-behavior intervention	4	2	2	45
		Multiple-behavior intervention	7	2	5	45
St. Lawrence, Jefferson, Alleyne & Brasfield (1995)	To compare a behavioral skills training intervention with an educational program	Multiple-behavior intervention	2	2	0	17
		Multiple-behavior intervention	4	2	2	17
Stephenson et al. (2011)	To examine a contraceptive method uptake	Multiple-behavior intervention	4	2	2	370
		Multiple-behavior intervention	5	2	3	374
		Multiple-behavior intervention	5	2	3	393
		Multiple-behavior intervention	6	2	4	365
Stewart et al. (2017)	To investigate an evidence-based risk reduction program on cocaine users	Multiple-behavior intervention	2	2	0	139
		Multiple-behavior intervention	5	2	3	112
Surratt & Inciardi (2010)	To evaluate two interventions on change in risk behavior	Multiple-behavior intervention	3	2	1	396
		Multiple-behavior intervention	6	2	4	410
Thato, Jenkins & Dusitsin (2008)	To assess the effects of a culturally sensitive sex education program	Control	0	0	0	261
		Multiple-behavior intervention	2	2	0	261
Thomas, Reynolds, Alterescu,	To assess the efficacy of an organizational network strengthening approach	Control	0	0	0	225
		Single-behavior intervention	1	1	0	234

Bevc & Tsegaye (2016)						
Thurman, Kidman, Carton & Chiroro (2016)	To evaluate psychological and behavioral interventions	Multiple-behavior intervention	2	2	0	229
		Multiple-behavior intervention	6	2	4	260
		Multiple-behavior intervention	8	2	6	243
		Control	0	0	0	282
Tobin et al. (2017)	To see the effect of an integrated cognitive behavioral therapy and HIV prevention intervention in reducing depressive symptoms and risky HIV behaviors	Control	0	0	0	153
		Multiple-behavior intervention	4	2	2	162
Tucker, D'Amico, Ewing, Miles & Pedersen (2017)	To evaluate a four-session, group-based motivational interviewing intervention to reduce alcohol and other drug use	Multiple-behavior intervention	6	2	4	100
		Control	0	0	0	100
Wandera et al. (2017)	To investigate the efficacy of a brief motivational intervention counseling in reducing alcohol consumption among people living with HIV/AIDS	Multiple-behavior intervention	5	2	3	170
Wang et al. (2010)	To determine the effect of a nurse-delivered home visits & telephone calls on adherence	Single-behavior intervention	1	1	0	50
		Multiple-behavior intervention	5	2	3	58
		Control	0	0	0	448



Wawer et al. (2009)	To determine whether circumcision in HIV-infected individuals would reduce transmission of the virus to sexual partners	Multiple-behavior intervention	4	2	2	474
Wechsberg, Luseno, Lam, Parry & Morojele (2006)	To determine the effect of an HIV prevention intervention	Multiple-behavior intervention	4	2	2	46
		Multiple-behavior intervention	5	2	3	47
Wechsberg et al. (2016)	To examine the effects of the Couples Health CoOp intervention on heavy drinking, condom use, and HIV incidence	Multiple-behavior intervention	4	2	2	200
		Multiple-behavior intervention	4	2	2	200
		Multiple-behavior intervention	4	2	2	200
Wernette, Plegue, Kahler, Sen & Zlotnick (2018)	To evaluate a computer-delivered brief intervention for substance use and risky sex during pregnancy	Control	0	0	0	19
		Multiple-behavior intervention	2	2	0	31
Williams, Myles, Sperling & Carey (2018)	To investigate whether a prevention intervention tailored for post-incarcerated men in reducing sexual risk	Control	0	0	0	125
		Multiple-behavior intervention	4	2	2	130
Wolitski, Gómez & Parsons (2005)	To assess the effects of a peer-led intervention on transmission risk behavior	Multiple-behavior intervention	2	2	0	413
		Multiple-behavior intervention	5	2	3	413
Zule, Costenbader, Coomes &	To compare the effects of two interventions on risky behaviors	Multiple-behavior intervention	10	2	8	428
		Multiple-behavior intervention	12	2	10	423

Wechsberg  
(2009)

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*Note.*

<sup>a</sup> The designation of a group as a control, single-behavior intervention, or multiple-behavior intervention was based on the number of recommendations prescribed to that group.

## APPENDIX D

## Outcomes measured in this meta-analysis

<b>Categories</b>	<b>Outcomes</b>
Risk Reduction	
Sexual Risk	Safe sex strategies Condom-protected sexual intercourse Condom use with your non-spousal partner Contraceptives other than condoms Unprotected sexual intercourse Multiple partners Sex and drinking Sex for drugs Sex for money Drugs for sex Unwanted pregnancy STI rates HIV prevalence
Substance-Related Risk	Substance use (e.g., alcohol use, drug use) Managing harmful consequences of alcohol use Sharing needles
Testing	HIV testing STI testing
Treatment	Use of services Intervention attendance HIV treatment STI treatment Drug treatment Medication adherence Biological variables (e.g., CD4 counts, viral loads) Serological follow-up Mortality rates
Psychosocial Health	Mental health (e.g., depression) Gender violence Past year physical and/or sexual IPV School dropout Quality of life (physical, psychological, social, and environmental)

*Note.* Effect sizes were coded such that positive scores represented improvements (e.g., increase in treatment adherence, decrease in drug use)

## APPENDIX E

## Coding exploratory study characteristics

**Description of the report.** We coded report characteristics, including the (a) publication year, (b) first authors' institution (e.g., college, hospital, research center), (c) first authors' institutional area (e.g., psychology, public health, medicine), (d) source type (e.g., journal article, dissertation), (e) location of the intervention, and (f) language the report was communicated in.

**Demographic and participant characteristics.** We also coded for characteristics of the sample, including the (a) sample size, (b) percentage of males in each group, (c) lowest, highest, and mean age, (d) percentage of participants of European, African, Latin, Asian, and Native American descent, (e) percentage of participants who completed high school and their mean years of education, and (f) percentage of participants who identified as heterosexual, gay, and bisexual.

We further coded for factors related to the intervention participants. We coded reports for (a) the specific sample targeted in the intervention (e.g., intravenous drug users), and recoded this variable to indicate whether the intervention targeted a vulnerable vs. not vulnerable populations (World Health Organization, 2015). We also coded for whether the intervention was (b) targeted to a specific ethnic group or (c) a specific gender group, and (d) whether the sample was self-selected, indicated by whether participation in the intervention was voluntary or whether the intervention made use of a captive audience (e.g., prison inmates).

**Intervention characteristics.** Finally, we coded for characteristics of the intervention programs. We coded for factors related to the design of the intervention, including (a) whether participants were randomly assigned to the intervention and control groups and (b) the mean number of days between the intervention and posttest. We also coded for factors related to the

implementation of these interventions. Specifically, we classified each intervention group according to (a) where participants were recruited (e.g., drug treatment facility, social service agency), and recoded this variable to describe a hospital/clinical setting vs. a non-hospital/clinical setting, (b) whether the facilitator was a professional (e.g., physician, nurse, social worker, professional counselor) or lay community member (e.g., community leaders and peers), (c) whether the intervention was delivered to a group, to individuals, or to a combination of the two, (d) what the exposure format (e.g., radio, brochure) was, which was recoded to indicate face-to-face vs. other formats, and (e) what the exposure setting (e.g., school, community) was, which was recoded to represent a clinical vs. non-clinical setting. We also determined (f) whether the intervention was described as culturally appropriate, (g) whether the intervention made use of active (e.g., behavioral skills training) or passive (e.g., informational arguments) strategies (Albarracin et al., 2005), and (h) whether the intervention relied on attitudinal elements (e.g., attitudinal arguments, threat arguments), motivational elements (e.g., feedback, encouragement), or skills training elements (e.g., role playing, goal setting) (Michie et al., 2015).

## APPENDIX F

## Descriptive statistics

Variable	Cases ( <i>k</i> = 136)
<b>General report characteristics</b>	
Publication year ( <i>r</i> = 1)	
M(SD)	2009.15(5.82)
<i>k</i>	125
Source type ( $\kappa$ = 1)	
Journal article	98.5(134)
Academic affiliation ( $\kappa$ = .91)	
University	27.9(38)
College	30.1(41)
Research center	14.7(20)
Hospital or health service	3.7(5)
CDC	0.7(1)
Medical School	2.9(4)
Institutional area ( $\kappa$ = 1)	
Psychology	12.5(17)
Community/public health	26.5(36)
Medicine	33.8(46)
Epidemiology	5.9(8)
Sociology	1.5(2)
Social work	1.5(2)
Language of the report ( $\kappa$ = 1)	
English	100.0(136)
<b>Demographic characteristics</b>	
Sample size ( <i>r</i> = 1)	
Sum total	59330
M(SD)	439.48(1050.23)
<i>k</i>	135
% men ( <i>r</i> = 1)	
M(SD)	58.40(35.79)
<i>k</i>	130
% women ( <i>r</i> = 1)	
M(SD)	41.07(35.66)
<i>k</i>	129
Age in years ( <i>r</i> = 1)	
M(SD)	30.03(10.38)
<i>k</i>	96
% heterosexual ( <i>r</i> = 1)	
M(SD)	44.89(43.19)
<i>k</i>	38

<b>Variable</b>	<b>Cases (<math>k = 136</math>)</b>
% gay or bisexual ( $r = 1$ )	
M(SD)	56.52(43.87)
<i>k</i>	36
Ethnic descent <sup>a</sup>	
% American ( $r = 1$ )	
M(SD)	21.13(27.79)
<i>k</i>	107
% African American ( $r = 1$ )	
M(SD)	36.02(35.60)
<i>k</i>	110
% Latin American ( $r = 1$ )	
M(SD)	14.66(24.15)
<i>k</i>	105
% Asian ( $r = 1$ )	
M(SD)	3.67(16.74)
<i>k</i>	86
% Native American Indian ( $r = 1$ )	
M(SD)	0.36(1.10)
<i>k</i>	87
% high school graduates ( $r = 1$ )	
M(SD)	39.81(30.84)
<i>k</i>	71
<b>Participant characteristics</b>	
Sample targeted by gender ( $\kappa = 1$ )	
Yes	41.9(57)
No	54.4(74)
Sample targeted by ethnicity ( $\kappa = 1$ )	
Yes	18.4(25)
No	77.9(106)
Targeted sample ( $\kappa = 1$ )	
HIV positive	18.4(25)
Intravenous drug user	5.9(8)
Drug dependent	8.8(12)
Men having sex with men	6.6(9)
Female sex workers	1.5(2)
Prison inmates	2.9(4)
Women	3.7(5)
African American women	2.2(3)
College students	1.5(2)
Middle school students	1.5(2)
Combination	11.8(16)
Self-selected sample ( $\kappa = 1$ )	
Yes	81.6(111)

<b>Variable</b>	<b>Cases (<math>k = 136</math>)</b>
No <sub>b</sub>	15.4(21)
Both	0.7(1)
<b>Intervention characteristics</b>	
Recruitment context ( $\kappa = 1$ )	
Hospital/health clinic	38.2(52)
Drug treatment	8.1(11)
Social service	2.9(4)
Bar	4.4(6)
Street	4.4(6)
Classroom	4.4(6)
Phone	0.7(1)
Multiple	12.5(17)
Random assignment ( $\kappa = .97$ )	
Yes	83.8(114)
No	12.5(17)
Exposure setting ( $\kappa = 1$ )	
Health clinic	37.5(51)
Community	13.2(18)
Schools	4.4(6)
Street	0.7(1)
Mass media	0.7(1)
Multiple contexts	7.4(10)
Delivery medium ( $\kappa = .97$ )	
Face-to-face	79.4(108)
Software	2.2(3)
Internet	0.7(1)
Television	3.7(5)
Radio	0.7(1)
Multiple context	5.3(7)
Delivery format ( $\kappa = 1$ )	
Groups	37.5(51)
Individuals	36.0(49)
Both	17.6(24)
Facilitator ( $\kappa = .93$ )	
Doctor/nurse	14.0(19)
Public health educator	19.9(27)
Clinical psychologist	6.6(9)
Medical student	0.7(1)
Community leader	2.2(3)
Gay leader	1.5(2)
Multiple	9.6(13)
Culturally appropriate ( $\kappa = .89$ )	
Yes	24.3(33)



<b>Variable</b>	<b>Cases (<i>k</i> = 136)</b>
No	72.8(99)
Days between intervention and post-test ( <i>r</i> = .88)	
M(SD)	21.56(112.84)
<i>k</i>	44

*Note.* Values are %(*n*) unless specified otherwise. *k* = number of reports. *r* = intercoder reliability for continuous variables.  $\kappa$  = intercoder reliability for categorical variables.

<sup>a</sup> reported for interventions conducted in North America, as these categories are not applicable to most other continents.

<sup>b</sup> includes captive audiences (e.g., participants recruited from a prison setting).

## APPENDIX G

## Data analytic plan

Our synthesis involved measuring change in outcomes between baseline and the first follow-up in experimental and control groups separately. Performing posttest comparisons between conditions is possible when one investigates the differences between a treatment and a control. However, we were interested in recommendation number. Such a comparison would have required a high level of imputation to estimate the impact of each recommendation number, higher than the norm for network meta-analyses (Caldwell et al., 2005; Glenny et al., 2005; Lumley, 2002). It was thus more appropriate to analyze change over time. Additionally, although many meta-analyses determine the efficacy of interventions relative to a control group, such an approach poses problems as well. As the type of control group used often varies between interventions (Karlsson & Bergmark, 2015), study outcome estimates are either based on an absolute comparison (when using a passive control group) or a relative comparison (when using an active control group), which can accordingly yield larger and smaller effects, respectively (Brookmeyer et al., 2016). Ascertaining intervention efficacy over time, with each individual serving as their own control, was therefore optimal.

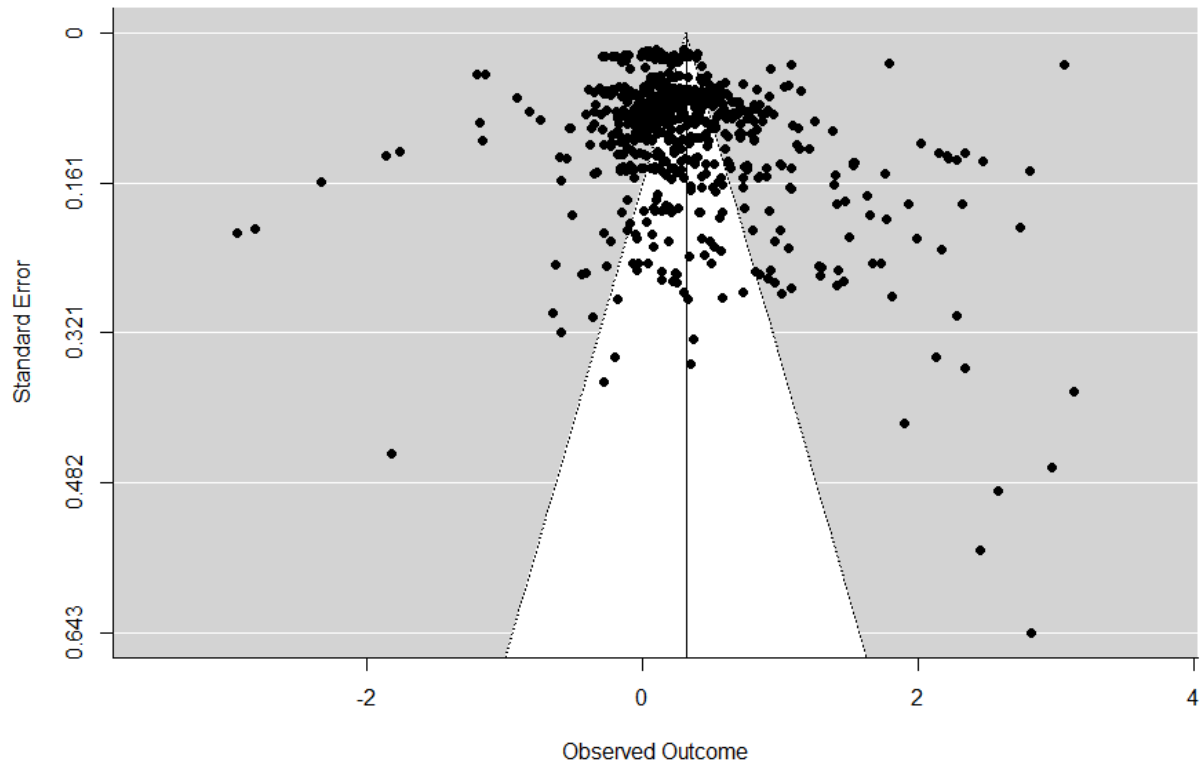
To represent change over time, we followed the meta-analytic methods outlined in Borenstein and colleagues (2009), which involved subtracting the mean at posttest from the mean at pretest, and dividing the difference by the standard deviation of the difference scores. Effect sizes were also calculated from proportions, which involved first calculating odds ratios and then transforming those to  $d$ . For cases in which the proportion was equal to 0 or 1 at either posttest or pretest, we applied the correction from Sweeting and colleagues (2004), which involved adding 0.005 to (or subtracting 0.005 from) both pretest and posttest scores. We then

obtained the natural log of the odds ratio, and divided it by 1.81, to convert this effect size measure into a Cohen's  $d$  (Chin, 2000). Finally, effect sizes were also calculated from exact reports of  $t$  tests,  $F$  ratios, and  $p$  values.

Unless indicated otherwise, data analysis was conducted using the R-based *robumeta* package (Tanner-Smith & Tipton, 2014). We also used the R-based *metafor* package (Viechtbauer, 2010), which provided plot functions to assess model fit and test for inclusion/publication bias.

APPENDIX H

Funnel plot for reports included in the meta-analysis



A funnel plot for reports included in this meta-analysis. A visual inspection of this funnel plot reveals a slight asymmetry, with studies missing on the left side.

## APPENDIX I

Results of intervention efficacy based on recommendation number

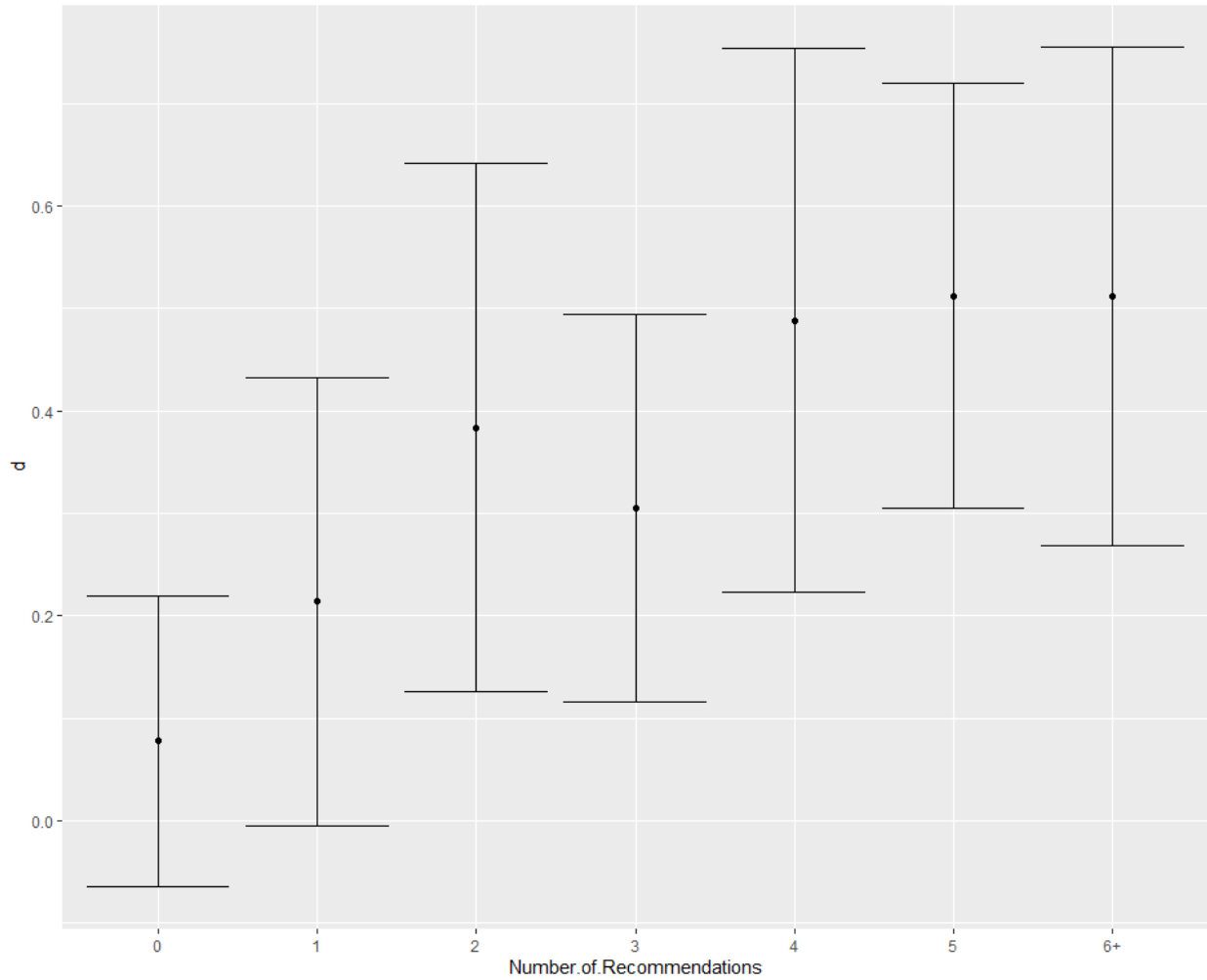
	Overall Outcome	Sexual Risk	Outcome Type <i>B</i> ( <i>SE</i> )			
			Substance-Related Risk	Testing	Treatment	Psychosocial Health
<b>All recommendations included</b>						
Recommendation number linear	0.07(0.01)***	0.06(0.02)***	0.08(0.02)**	0.11(0.10)	0.07(0.04)	0.19(0.11)
Recommendation number squared	-0.01(0.01)	-0.01(0.00)*	0.00(0.01)	-0.03(0.02)	0.02(0.01)	-0.07(0.04)
<b>Only main recommendations included</b>						
Recommendation number linear	0.11(0.03)***	0.06(0.02)***	0.08(0.02)**	0.11(0.10)	0.07(0.04)	0.19(0.11)
Recommendation number squared	-0.02(0.01)	-0.01(0.00)*	0.00(0.01)	-0.03(0.02)	0.02(0.01)	-0.07(0.04)

*Note.* For some interventions, no auxiliary recommendations were given. In these cases, the estimated coefficient values are the same between all and main recommendations. *B* is the estimated coefficient. *SE* is the standard error.

\*  $p < .05$  \*\*  $p < .01$  \*\*\*  $p < .001$

APPENDIX J

The weighted-mean average of overall change for each recommendation number

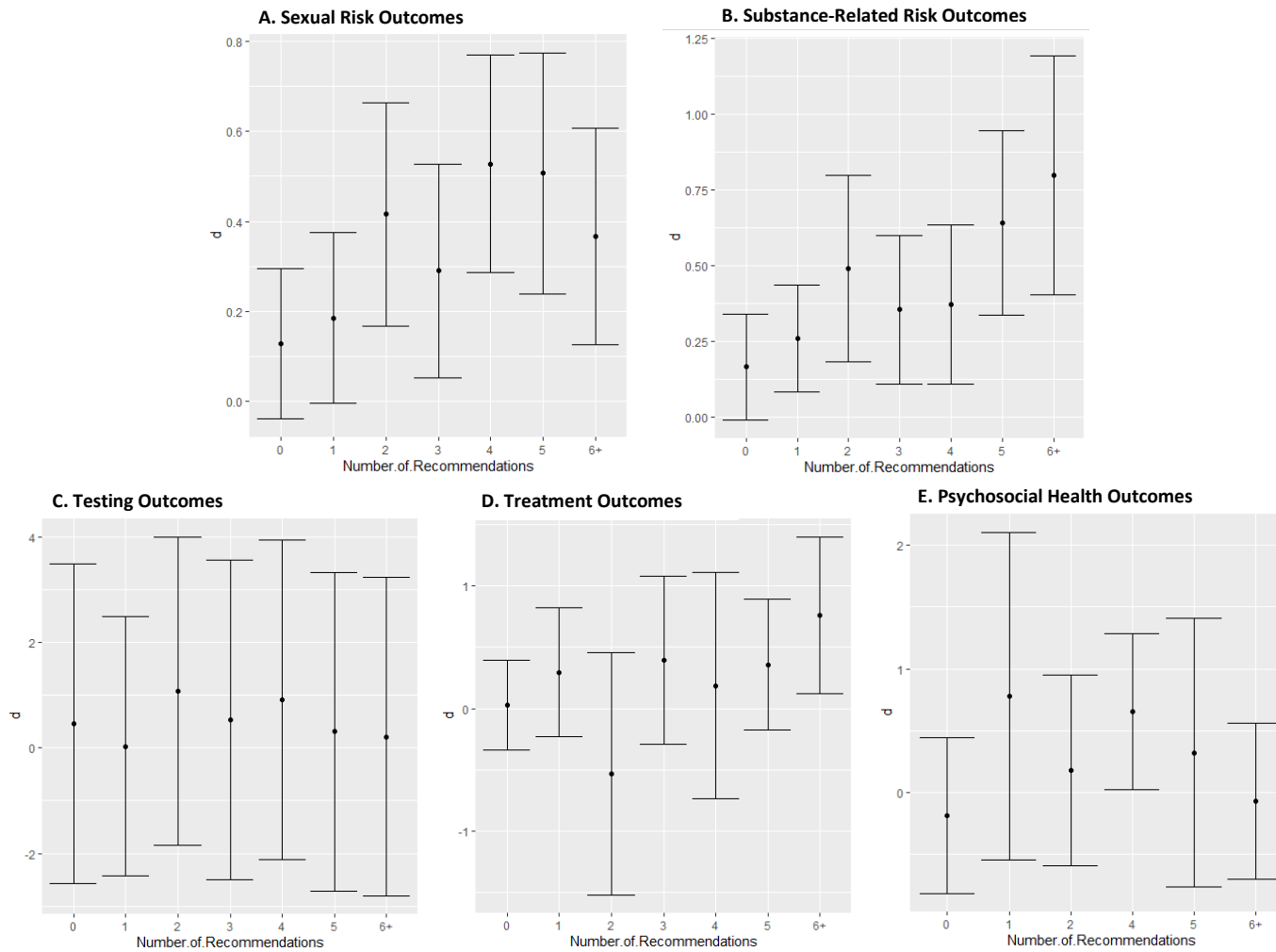


The weighted-mean average of overall change for each recommendation number.

Recommendation number was treated as a continuous variable in the meta-regression model. For plotting purposes, however, interventions recommending 6 to 14 recommendations were grouped together.

APPENDIX K

The weighted-mean average of overall change for each recommendation number for outcomes



The weighted-mean average of overall change for each recommendation number for outcomes related to (A) sexual risk, (B) substance-related risk, (C) testing, (D) treatment, and (E) psychosocial health. Recommendation number was treated as a continuous variable in the meta-regression model. For plotting purposes, however, interventions recommending 6 to 14 recommendations were grouped together.



## APPENDIX L

## Exploratory moderator analyses

We also conducted moderator analyses to determine whether there were participant or intervention characteristics that influenced intervention efficacy. All moderator analyses were first conducted with the full sample. However, where the moderators of interest (e.g., exposure setting, delivery format) only pertained to intervention groups, control groups recommending no behavior were excluded. Interventions were more efficacious when they recruited participants from a hospital/clinic setting ( $d = 0.49$ ,  $CI = [0.31, 0.67]$ ,  $k = 117$ ), than when they did not ( $d = 0.23$ ,  $CI = [0.13, 0.33]$ ,  $k = 73$ ). This suggests that targeting those who are already seeking health services improves intervention success. These results are consistent with previous reviews (Albarracín et al., 2005) that have found similar moderating effects, and suggest that future interventions may benefit from targeting those who are already motivated to change. In addition, interventions were also more efficacious when they incorporated random assignment ( $d = 0.40$ ,  $CI = [0.20, 0.60]$ ,  $k = 248$ ), than when they did not ( $d = 0.03$ ,  $CI = [-0.16, 0.21]$ ,  $k = 35$ ). This suggests that methodological factors can impact the detection of intervention effects. Although the interpretation of these results are unclear, they could suggest that those interventions that are more methodological rigorous also include other characteristics that contribute to intervention success. The rest of the moderators had no significant effect.

## APPENDIX M

## References included in the appendices

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