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## A Meta-analytic Approach To Examining Psychosocial Correlates Of Risk In Hiv-diagnosed And Hiv-nondiagnosed Men Who Have Sex With Men

Katharine Lacefield  
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A META-ANALYTIC APPROACH TO EXAMINING PSYCHOSOCIAL CORRELATES OF  
RISK IN HIV-DIAGNOSED AND HIV-NONDIAGNOSED IN MEN WHO HAVE SEX WITH  
MEN

by

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M.S. University of Central Florida, 2010

A dissertation submitted in partial fulfillment of the requirements  
for the degree of Doctor of Philosophy in Clinical Psychology  
in the Department of Psychology  
in the College of Sciences  
at the University of Central Florida  
Orlando, Florida

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2013

Major Professor: Charles Negy

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## **ABSTRACT**

Human Immunodeficiency Virus (HIV) continues to disproportionately affect men who have sex with men (MSM). Gay, bisexual, and other MSM are estimated to account for two percent of the population, yet they constitute more than half of all individuals living with HIV in the United States (Centers for Disease Control [CDC], 2010). Collectively, both HIV-diagnosed (HIV-D) and HIV-nondiagnosed (HIV-ND) MSM report a variety of reasons for intentional and unintentional nonuse of condoms. Depending on partner status, HIV-D MSM are in the unique position of having the potential both to increase risk of infecting others with HIV and to expose themselves to further complication (e.g., superinfection) when they engage in unprotected anal intercourse (UAI). HIV-ND MSM are at risk of seroconversion each time they engage in UAI with an infected partner or partner of unknown HIV status. Elucidating reasons for continued engagement in UAI specific to both HIV-D and HIV-ND MSM likely is an important step in the process of effective prevention. The current study employed meta-analytic methods to evaluate HIV-risk correlates in both HIV-D and HIV-ND MSM. In addition to several individual risk correlates, within the context of the Information-Motivation-Behavioral Skills Model, Behavioral Skills variables were related to condom use in HIV-ND MSM and Motivation variables were related to condom use in both HIV-D and HIV-ND MSM. A sufficient number of studies were not available to examine Information-based risk correlates in either subgroup. Results of the present study may guide future best practice in harm reduction for both HIV-D and HIV-ND MSM.

For My Gary. Every time I hear the key in the door, I know the party's about to start.

## **ACKNOWLEDGMENTS**

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## **CHAPTER ONE: INTRODUCTION**

Human Immunodeficiency Virus (HIV) remains a public health concern, especially for men who have sex with men (MSM). MSM currently comprise approximately 70% of HIV positive men living in the United States and 61% of new cases (Centers for Disease Control [CDC], 2007; CDC, 2010). Despite this, MSM increasingly are reporting high-risk sexual behavior (Osmond, Pollack, Paul, & Catania, 2007). Although advancements in medical treatment of HIV have been made since the inception of the epidemic in the 1980s, there remains no cure for HIV. A major obstacle to provision of appropriate medical interventions, however, is the frequently undisclosed serostatus of HIV-diagnosed (HIV-D) MSM. The CDC estimated that 44% of HIV-infected MSM living in a major U.S. city are unaware of their infection status (CDC, 2010). Although in these cases appropriate medical treatment is not an option until a diagnosis is made, increased appreciation for serotesting is a necessary initial step to minimize the transmission of HIV to new sexual partners. Moreover, one recent study found that, among a sample of MSM ( $n = 4,295$ ), 54.9% had engaged in unprotected anal intercourse (UAI) in the past six months (Koblin et al., 2006). Thus, understanding variables related to engaging in UAI may provide useful insight into decreasing risky sexual practices among both HIV-D and HIV-nondiagnosed (HIV-ND) MSM at risk for HIV and HIV complications. Additionally, promotion of safer sex practices with behavioral change related to prevention becomes paramount for all MSM engaging in risky sex behavior (i.e., less than 100% condom use).

### **Information-Motivation-Behavioral Skills Model**

Given the breadth of variables likely related to risky sex in MSM, a framework was used to help organize them in analysis. Although several frameworks have been posited (e.g., AIDS

Risk Reduction Model [Catania, Kegeles, & Coates, 1990], Health Belief Model [Rosenstock, 1994], Bandura's self-efficacy framework [1986], and Protection Motivation Theory [Rogers, 1983]), the Information-Motivation-Behavioral Skills (IMB) Model offers a more comprehensive framework than others. The IMB model posits that HIV risk behavior will be reduced if an individual has accurate information pertaining to risks, motivation to change behavior, and the behavioral skills to implement the change (Fisher & Fisher, 1992). These categories are left intentionally broad and may include a range of risk factors. Examples of variables assessed within the Information category may be knowledge of higher- versus lower-risk sexual activities (e.g., increased risk with receptive, versus insertive, anal sex) or other items assessed on measures such as the "AIDS Information Heuristics" subscale (Fisher, 2011). The Motivation category is comprised of HIV perceived personal vulnerability, attitudes, and prevention norms that assess the level of motivation an individual expresses to use or not use a condom. The Behavioral Skills category assesses both primary risks for contracting HIV (not using condom during receptive anal intercourse), intentional condom nonuse (barebacking), and secondary risk behavior (being under the influence of a substance during sex), as well as for perceived self-efficacy for using the behavioral skills.

Although the IMB Model has effectively been used to predict HIV-risk related behavioral change (e.g., Fisher, 2011; Nöstlinger et al., 2011; Walsh, Senn, Scott-Sheldon, Venable, & Carey, 2011), it may be somewhat limited in its utility beyond a framework from which to examine risk variables and potentially guide clinical interventions (Kalichman, Picciano, & Roffman, 2008). Additionally, it was beyond the scope of this study to examine the predictive accuracy of the model, as the intention is to examine and compare the relation of each variable with HIV sexual risk behavior in HIV-D and HIV-ND MSM.

## **Sexual Risk Behavior and HIV-diagnosed MSM**

HIV-D MSM are in the unique position of having the potential to both infect others, and exacerbate their own symptoms by engaging in UAI. A recent meta-analysis investigating the prevalence of UAI in HIV-D MSM revealed that, across studies and partner type and partner serostatus (primary versus casual; seropositive, seronegative, serostatus unknown), 43% of participants reported having engaged in UAI (Crepaz et al., 2009). Of those with seropositive partners, 30% reported engaging in UAI as compared with 16% with serostatus unknown partners and 13% with seronegative partners. With regard to type of UAI (receptive or insertive), Crepaz and colleagues (2009) found little difference with a seropositive partner (22% reported receptive UAI, 21% reported insertive UAI), whereas with a seronegative partner, HIV-D MSM report reduced incidence of insertive UAI (9% reported receptive UAI, 5% reported insertive UAI). These prevalence rates suggest the need for ongoing attention to “prevention with positives,” an integral component in reducing incidence of HIV (Fenton, 2010).

In the case of HIV-D MSM who practice serosorting wherein they deliberately seek out HIV-D partners with whom to engage in UAI, an HIV-D person’s health can deteriorate due to several causes, including: increased risk sexually transmitted infection (STI) susceptibility, including hepatitis B and C and other opportunistic infections (Bonell, Hickson, Beaumont, & Weatherburn, 2008; Kalichman, Rompa, & Cage, 2000; Mendes-Corrêa, Barone, & Guastini, 2001; Rezza & Andreoni, 1999), rapid loss of CD4 cells (Wiley et al., 2000), and HIV-reinfection or HIV-superinfection (Blackard, Cohen, & Mayer, 2002; Hague, Muvva, & Miazad, 2011; Hickson, Beaumont, & Weatherburn, 2008; Smith, Richman, & Little, 2005). HIV-superinfection refers to the infection of an already infected individual by two genetically unique

viruses. These viruses can be the same or different subtype (Blackard, Cohen, & Mayer, 2002). Although documented cases of HIV-superinfection exist, little is known about the transmission process or prevalence rates. An established outcome of HIV-superinfection, however, is reduced CD4 cells (Brenner et al., 2004) and increased viral load (Quinn et al., 2000), each a unique indicator of a problematic prognosis in those diagnosed with HIV (Lyles et al., 2000). Although information about HIV transmission prevention behaviors (e.g., using condoms) is routinely provided, guidance about HIV-superinfection in those already diagnosed with HIV may be less routinely expressed or less likely to be comprehended by patients, resulting in continued serosorting as a perceived risk reduction behavior. Similarly, although contracting HIV may seem to be the worst possible consequence of engaging in UAI, thereby reducing concern about other STIs in those individuals already diagnosed with HIV, research suggests that susceptibility to contracting illnesses (e.g., hepatitis C, syphilis, and chlamydia) increases with HIV diagnosis (Kalichman, Rompa, & Cage, 2000). Although these illnesses may not seem to be as threatening in those diagnosed with HIV, they can have a detrimental effect in antiretroviral treatment and may complicate HIV symptoms (Guttman, 1998; Salmon-Ceron et al., 2005).

Despite compelling reasons to reduce or abstain from UAI after HIV diagnosis, a substantial portion of HIV-D MSM opts to engage in UAI with seropositive partners. Perhaps more concerning, however, is the smaller percentage of HIV-D MSM who report engaging in UAI with unknown serostatus or seronegative partners. Although transmission of HIV does not occur with every sexual contact, the potential for viral spread exists each time (1.43% per receptive UAI when partner ejaculates and has undetectable viral load [Jin et al., 2010]; 4.6% per receptive UAI when partner has unsuppressed viral load [Hall, Holtgrave, Tang, & Rhodes [2013]]). Despite relatively low risk of transmission with each sexual contact, MSM continue to

be disproportionately affected by HIV (CDC, 2007; CDC, 2010). Although disclosure of positive serostatus seems essential to promoting reduced risk of HIV transmission, results of a recent study suggest that only 46% of HIV-D MSM report disclosure of their status with every sexual partner (Klitzman et al., 2007). Correlates including ethnicity, time since diagnosis, low emotional involvement, and alcohol use have been identified as reasons for nondisclosure (see review by Sullivan, 2005). Among the most high-risk subgroups of MSM are those who identify as barebackers, whose sexual behaviors are characterized by intentional UAI (Gauthier & Forsyth, 1999).

Barebacker refers to an identity characterized by deliberate engagement in sex without wearing a condom, generally among MSM. This is distinguished from the large percentage of MSM who report at least one instance of UAI, which may be described as unplanned or a “slip up,” by the deliberate nature of the act and by the intentional self-given label of barebacker. Concerns related to barebacking have developed related to HIV risk as the phenomenon continues to grow in popularity among MSM (see Berg, 2009 for a review; da Silva & Bernstein, 2012; Klein & Tilley, 2012; Rojas Castro et al., 2012). The Internet has played a pivotal role in connecting MSM who identify as barebackers, with multiple websites catering to this population (Dawson, Ross, Henry, & Freeman, 2005; Gauthier & Forsyth, 1999; Nodin, Valera, Ventuneac, Maynard, & Carballo-Diéguez, 2011). Estimates of MSM who identify as barebackers range from 10-14% (Mansergh et al., 2002) to 45% (Halkitis, Parsons, & Walton, 2003), with one study examining HIV-D MSM living in major United States cities reporting 27.2% of their relatively large sample identifying as barebackers (Halkitis, Wilton, Wolitski, Parsons, Hoff, & Bimbi, 2005) versus 12.3% of HIV-D MSM sampled in London, England (Elford, Bolding, Dabis, Sherr, & Hart, 2007). Among self-identified barebackers, a greater proportion co-

identifies as HIV-D than HIV-ND (Parsons & Bimbi, 2007). Although this is concerning from a public health perspective, many HIV-D barebackers attempt to engage in perceived harm reduction strategies including serosorting or intentionally acting as the receptive partner during UAI (Elford, 2006; Elford, Bolding, Davis, Sherr, & Hart, 2007; Parsons & Bimbi, 2007).

Beyond those individuals who identify as a member of a group characterized by intentional condom nonuse, a large portion of HIV-D MSM engage in unplanned, inadvertent UAI for a variety of reasons to be explored in the current analysis. Within the framework of the IMB Model, these correlates were examined as falling into categories of information, motivation, or behavioral skills. A primary aim of the current study was to systematically review all published empirical research germane to the topic of HIV risk correlates in HIV-D MSM, and therefore the results of this study include a synthesis of the variables. Extant literature reveals several correlates for analysis pertaining to each category of the IMB Model.

### **Sexual Risk Behavior and HIV-nondiagnosed MSM**

Although only HIV-D individuals are able to transmit the virus, understanding variables for UAI in HIV-ND MSM is an equally necessary component in reducing the spread of HIV. In a large United States sample ( $n = 8,175$ ) of HIV-ND MSM, 54% of participants reported engaging in UAI with male partners during the past 12 months (Finlayson et al., 2011). Of those, 37% reported having UAI with their primary partner, 25% reported having UAI with a non-primary partner, and 8% reported engaging in UAI with both a primary and non-primary partner during the past 12 months (Finlayson et al., 2011). Further, results of their study revealed that 37% of participants were unsure of the HIV serostatus of their most recent male sexual partner. Additionally, among the sample of HIV-ND MSM, 39% had met their most recent sex partner at a bar or club, and 20% had met their partner on the Internet, two avenues associated with



increased risk (Colfax & Guzman, 2006; Garofalo, Herrick, Mustanski, & Donenberg, 2007). As is the case for HIV-D MSM, HIV-ND MSM report sundry reasons for nonuse of condoms; also like HIV-D MSM, reasons cited by HIV-ND MSM for nonuse of condoms can be differentiated by intentional and unintentional motivation.

For a minority of HIV-ND MSM, nonuse of condoms is an intentional practice. Although “barebacking” originally was a term reserved for HIV-D men (O’Hara, 1997), HIV-ND MSM and MSM of unknown HIV status have adopted it as well. Among this HIV-ND MSM, studies report prevalence of barebacking to range between 7% (Mansergh, 2002) and 41.8% (Halkitis et al., 2003), consistently with lower rates than reported by HIV-D MSM. Unsurprisingly, HIV-ND MSM have reasons that differ from those of HIV-D MSM for why they choose to engage in the deliberate nonuse of condoms. In one study, 47.9% of gay and bisexual men surveyed in New York City cited advances in HIV treatment as the primary reason for increases in barebacking (Halkitis et al., 2003). Similarly, in a London sample of MSM, decreased concern about HIV was positively related with barebacking (Elford et al., 2007). Although deliberate condom nonuse, especially with HIV-D or unknown serostatus partners, presents increased risk for the spread of HIV, HIV-ND barebackers often report using harm reduction strategies during UAI. These strategies include being much more likely to act as the insertive partner (top) rather than receptive (bottom) partner during sex (Halkitis et al., 2005; Van de Ven et al., 2002; Wegesin & Meyer-Bahlburg, 2000), to engage in serosorting for concordant partners (Dawson, Ross, Henry, & Freeman, 2005), and to ejaculate externally (Van de Ven et al., 2002). Unfortunately, the effectiveness of these strategies is contingent upon certainty of HIV status between partners and extant data suggest a modest effect on transmission risk (Golden, Stekler, Hughes, & Wood, 2008).

In two comprehensive review studies published in the mid-1990s, correlates of HIV condom nonuse were examined (Flowers, Sheeran, Beail, & Smith, 1997; Hospers & Kok, 1995). Flowers et al. used the framework of the AIDS Risk Reduction Model (AARM) to categorize variables most associated with the process of behavior change. The three stages of AARM (i.e., Labeling, Commitment, and Enactment) mirror the stages of the IMB model in many ways by examining change as a process rather than as a random predictor variable. In their study, the authors quantitatively observed being in a steady relationship, an Enactment variable, to have the strongest relation to UAI, conceivably because these MSM perceive monogamy as a risk-reduction strategy. The literature review conducted by Hospers and Kok (1995) presented demographic variables, situational and behavioral variables (e.g., relationship status and substance use), psychosocial variables (e.g., knowledge, perceived risk, attitude, social influence and norms, and self efficacy). Each of these variables fits within the IMB framework. These variables were presented as potentially impacting HIV risk based on the literature available in the pre-HAART HIV/AIDS era; however, without the use of meta-analysis, meaningful interpretation of a variable's contribution to HIV risk behavior is nebulous.

### **Summary of Literature Review**

Collectively, both HIV-D and HIV-ND MSM report a variety of reasons for intentional and unintentional nonuse of condoms. Depending on partner status, HIV-D MSM are in the unique position of having the potential both to increase risk of infecting others with HIV and to expose themselves to further complications (e.g., reinfection or superinfection) when they engage in UAI. HIV-D MSM who identify as barebackers, those who do not disclose their status to sex partners, and those who engage in unintended UAI contribute to the spread of HIV. HIV-ND MSM are at risk of seroconversion each time they engage in UAI with an infected partner or

partner of unknown HIV status. HIV-ND MSM also report both intentional and unintentional motivation for nonuse of condoms. Those who identify as barebackers may attempt to engage in perceived risk reduction behaviors with limited effect; however, widespread unintentional nonuse of condoms among HIV-ND MSM contributes to the virus' disproportionate effect on MSM. Elucidating reasons for continued engagement in UAI specific to both HIV-D and HIV-ND MSM is an important step toward effective prevention.

### **The Current Study**

HIV continues to disproportionately affect MSM. Gay, bisexual, and other MSM are estimated to account for 2% of the U.S. population, yet they constitute more than half of all individuals living with HIV in the United States (CDC, 2010). Despite that condoms have been found to effectively prevent the spread of HIV, significant portions of both HIV-D and HIV-ND MSM report UAI. The current study aimed to synthesize decades of research on the topic of correlates to HIV risk in the distinct populations of HIV-D and HIV-ND MSM, with the understanding that variables affecting UAI may be quite different for the two subgroups of MSM. Clarity with respect to risk correlates in each of these populations may be crucial to determining effective prevention strategies with each group.

With the potential risks to each group of MSM in mind, the current study sought to answer the following questions:

1. What are the psychosocial and behavioral correlates of HIV risk in both HIV-D and HIV-ND MSM?
2. What is the strength of the relation between each variable or combination of variables and HIV risk within each subgroup of MSM (HIV-D and HIV-ND)?

3. Within the IMB Model, does one category yield variables with relatively stronger association with unsafe sex?

Beyond the stated aims of the current study, moderating variables of interest were expected to affect the strength of the relation between each correlate and UAI. These variables were average age of the sample (i.e., more than 40 years of age or 40 years of age or younger), location (i.e., whether the study occurred within the United States or outside of the United States), data collection date (i.e., whether data were collected in or before 2002 or after 2002), as well as four variables pertaining to the study's operational definition of sex, when available, partner status (i.e., whether the partner was primary or non-primary/casual), partner's serostatus (i.e., concordant or discordant), sex position (i.e., receptive, insertive, or any UAI), and timeframe during which sex was assessed (ranged from "last encounter" to "in the past 5 years").

Average age of the sample was expected to correlate with Motivation correlates, as young MSM are unlikely to have been sexually active during the height of AIDS-related deaths and may perceive less risk than their older counterparts. Similarly, data collection date was of interest as the relatively recent availability of highly active antiretroviral therapy (HAART) has propelled a shift in many individuals' perception of HIV from that of a "death sentence" to a chronic medical condition (Halloran, 2006; Reiter, 2000). In light of these recent findings, two hypotheses were proposed:

1. Perceived risk of UAI and contracting HIV will be significantly lower in data collected after 2002 compared to data collected prior to 2002 because of Food and Drug Administration approval of HAART in 1996. This buffer will be used to increase the likelihood that participants included in studies after 2002 would have had access to HAART.

2. Younger participants will endorse significantly less perceived risk associated with UAI or acquiring HIV than will older participants.

Additionally, although one intention of the current study was to categorize risk correlates within the framework of the IMB Model, during the process of comprehensive literature review, additional variables were identified. In this instance, all variables meeting the inclusion criteria were included in analysis. Determination of the IMB Model category in which the variable will be included will occur based on fit with criteria for each category as proposed by Fisher and Fisher (1992) and later studies that have adapted and augmented the framework. Although the IMB Model accounted for several variables included in analysis, results for those that were not appropriate within the framework are presented as individual correlate types.

## CHAPTER TWO: METHOD

The present study was designed, conducted, and reported in adherence with the Quality of Reports of Meta-analyses (QUOROM) statement, developed to improve the standards by which meta-analytic results are presented (Moher et al., 1999).

### Searching

To identify all germane studies, a literature search was conducted using both a top-down and bottom-up approach. The top-down approach was satisfied with a literature search using the online databases PsycInfo, PsycARTICLES, Medline, Health Source: Nursing/Academic Edition, and Cochrane Database of Systematic Reviews. The search terms [(HIV\* or Human Immunodeficiency Virus\* or AIDS\* or Acquired Immune Deficiency Syndrome\*) AND (correlate\* or predictor\* or factor\* or variable\*) AND (MSM\* or men who have sex with men\* or gay\* or bisexual\*) AND (condom\* or unprotected anal intercourse\* or UAI\*)] were used. These findings were further limited to studies published in a peer-reviewed journal, available in English, and involving human participants through December of 2012. The requirement of studies published in peer-review journals was included to increase transparency and replicability of results, and to ensure that studies included have met a minimum degree of methodological rigor (Rosenthal & DiMatteo, 2001). The full-text of articles deemed appropriate were obtained as well as those for which relevance could not be determined. Using a bottom-up approach, the references of each full-text article included were reviewed for identification of additional studies missed during the database searches.

## Selection

Inclusion criteria for studies considered was based, in part, on the meta-analysis of correlates of condom use in heterosexual individuals conducted by Sheeran, Abraham, and Orbell's (1999). The current study had similar aims to identify correlates of condom nonuse during intercourse, as the primary dependent variable, although the population of interest is MSM, both HIV-D and HIV-ND. The criteria for inclusion were:

1. The current study sought to identify correlates of condom use during anal intercourse. Therefore, studies that use *intention* to use condoms as the sole outcome variable were not included.
2. Consistent with the stated outcome variable of interest for the current study, studies that do not distinguish condom use from other proposed measures of risk (e.g., reduced number of sexual partners, engaging in alternative sexual behaviors) were not included.
3. Studies that use condom use at first sexual contact as the sole outcome variable were not included, as this has been identified as a predictor variable more than a dependent variable (Sheeran & Abraham, 1994).
4. Studies included for analysis in the current study report bivariate statistical information between at least one correlate and self-reported condom use.

In addition to these requirements guided by previous research, additional criteria specific to the population of interest were:

5. Information necessary to calculate effect size is reported.
6. Study samples included adolescent or adult males who were identified as MSM, gay, or bisexual.

7. Males in the included studies are identified as being either HIV-D or HIV-ND.
8. Data not reported as an association between specific HIV status, risk correlate, and risk behavior were excluded from analysis.
9. Transgender samples were excluded from analysis.
10. Samples in which participants first became aware of a reactive serotest during data collection were excluded.

### **Validity Assessment**

The primary author independently screened all studies yielded from the initial search. Of those deemed appropriate for further review, a three-person coding team was used to determine inclusion eligibility and coding of primary studies included for analysis. Intrarater and interrater reliability were recorded for excluded articles, only. To reduce coder error, undergraduate coders were trained and underwent pilot testing of the coder protocol by the primary author prior to a second coder assessing for inclusion criteria and coding the articles. They were allowed to independently code only after achieving 100 percent reliability on blinded trials of inclusion/exclusion and coding decisions. Meetings via telephone occurred weekly between each coder and the primary author thereafter to assess for coder bias and coder drift in an effort to reduce coder error (Cooper, Hedges, & Valentine, 2009). Sensitivity was emphasized over specificity to coders during their validity assessment, resulting in use of a “help” folder wherein articles about which they were unsure were placed for the primary author to review. Following initial completion of validity assessment, 20 percent of the articles reviewed by the primary author and 20 percent of the articles assessed by the two assistant coders were re-reviewed for intra- and inter-rater reliability.



## **Data abstraction**

Data from articles deemed appropriate for inclusion were abstracted independently by the three-person coding team, including the primary author. Data were recorded onto a comprehensive coding sheet (see Appendix A) for entry into the data analytic software. The 69 articles coded by the two research assistants were reassessed by the primary author for inclusion and accuracy of coding results. The data abstraction became iterative in that data necessary for calculating effect sizes were presented in various formats within articles. Unlike a standard randomized control trial that may report group differences or pre- post-treatment effects as odds ratios or differences in means and standard deviation, the literature relevant to the topic of interest presented findings in 10 different formats within text and in tables. To help ensure accuracy and reliability in data abstraction, a doctoral-level statistician was employed as a consultant for data abstraction and analyses. The primary author met with the expert statistician weekly for seven weeks during the abstraction and analysis phase of the study to review questionable studies, and to determine the optimal method of data abstraction given the analytic software used. The primary author abstracted data from all included studies for input into the statistical software, and approximately fifty percent of these studies were discussed and agreed upon between the primary author and the statistician.

## **Quantitative Data Synthesis**

Meta-analysis was conducted using Comprehensive Meta-Analysis Version 2.0 (CMA), a computer program that allows for the computation of multiple effect sizes from a variety of reported data formats (Borenstein, Hedges, Higgins, & Rothstein, 2007). Two sets of meta-analyses were conducted. First, each variable's association with UAI was meta-analyzed within

each population (e.g., the strength of illicit drug use as a risk variable was analyzed separately for HIV-D MSM and HIV-ND MSM). Additionally, the collective effect size for each category of variables (i.e., Information, Motivation, Behavioral skills) within each population was calculated when available. By doing so, the goal was to elucidate the phase of the change process most strongly associated with condom use to inform future best practice of decreasing condom nonuse by both HIV-D and HIV-ND MSM. Further, by examining risk correlates specific to each subpopulation of MSM, interventions may be tailored to address the needs specific to each group.

The effect size (ES) was expressed as odds ratio (OR) and 95% confidence intervals (CI). Specifically, an OR of the odds that a given variable relates to condom nonuse is presented. Given expected differences in variance and true effect sizes among studies (e.g., based on assessed moderator variables), the random effects model was chosen. The random effects model assumes that true effects are normally distributed and places weights on studies based on sample size. This helps to ensure that studies with larger sample sizes do not dominate analysis, while studies with smaller sample sizes are minimized (Borenstein, Hedges, Higgins, & Rothstein, 2007). The  $Q$  statistic and  $I^2$  were calculated as tests for heterogeneity to evaluate variance in effect size across studies within an identified risk category. A significant  $Q$  statistic indicates that the true effects vary across studies due to multiple population parameters.  $I^2$  is a measure of the proportion of observed variance that is indicative of true effect size differences and is not impacted by the number of studies included (while  $Q$  is [Borenstein, Hedges, Higgins, & Rothstein, 2009]). Potential moderator variables were examined contingent upon a significant  $Q$  statistic. A significant  $Q$  statistic indicates the likelihood that differences between effect sizes are due to some systematic variance among effect sizes that may be attributed to moderator variables

(Hedges, 1994). Significant moderators and their  $p$  values are reported for each risk correlate wherein heterogeneity was significant.

The unit of interest for the present study was risk correlate, rather than the study itself, resulting in multiple outcomes for most studies included. Additionally, outcomes were examined separately for the subgroups of HIV-D and HIV-ND MSM, respectively.

Publication bias is of concern for any meta-analytic review, as statistically significant results are more likely to be published than those that are not statistically significant (see Dickersin, 1997 for a review). The present study used Rosenthal's *Fail-safe N* to estimate the number of missing studies that would be needed to nullify the effect (Rosenthal, 1979). The smaller the fail-safe  $N$ , the more likely the possibility that the true effect size is zero (Borenstein, Hedges, Higgins, & Rothstein, 2009).

## CHAPTER THREE: RESULTS

Agreement among coders for validity assessment of articles excluded from analysis was 100 percent. Intrarater agreement conducted by the primary author revealed one study, initially excluded, that was deemed appropriate on second non-blind review and ultimately included in analysis. As mentioned previously, sensitivity was valued over specificity for inclusion consideration and coding. This resulted in 11 studies identified by assistant coders as appropriate being later excluded, due primarily to statistical abnormalities making effect size calculations impossible. Decisions for exclusion of these studies ultimately were made by the primary author in consultation with the expert statistician.

The literature search revealed a total of 79 studies (78 unique samples), published between 1993 and 2012, that described the correlation between a specified HIV risk correlate and UAI within a specified HIV population of MSM, resulting in 690 unique correlations between the variables of interest. These studies with descriptive information and variables of interest are presented in Table 1. Two studies that shared a sample were treated as one study in analyses, so as not to inflate outcomes artificially (Yi, Sandfort, & Shidlo, 2010; Yi, Shidlo, & Sandfort, 2011). In total, 58 studies met inclusion criteria for HIV-D MSM, and 36 studies met inclusion criteria for HIV-ND MSM (16 studies presented results for both HIV-D and HIV-ND MSM). Study sample sizes ranged from 7 to 13,901 ( $M = 773$ ).

### **HIV-diagnosed MSM**

Fifty-eight studies were included to examine the global relation between psychosocial risk correlates and UAI. The effect was significant with zero falling outside the confidence interval,  $ES = 1.382$ , 95% CI [1.192, 1.601]  $p < .001$ , indicating a relation between psychosocial

risk factors and UAI. As would be expected, given the range of variables included in this global analysis, tests of heterogeneity were significant for the effect size,  $Q(57) = 436.748, p < .001, I^2 = 86.949, T^2 = 0.215$ . Given the significant heterogeneity among studies, moderator variables were examined. Location and data collection date significantly moderated the relationship between global risk correlates and UAI in HIV-D MSM ( $p = .001$  and  $p = .030$ , respectively). The fail-safe  $N$  for the overall effect size was 1184 studies. Figure 2 provides a summary of forest plots for studies included for the subgroup of HIV-D MSM.

Among these 58 studies, 50 included outcome data that could be grouped with at least two other studies' data for meta-analysis. A criterion for inclusion as a "correlate type" was a minimum of three studies examining a particular variable, to satisfy requirements for calculation of a fail-safe  $N$  within the CMA program. Risk correlates included for independent meta-analysis in HIV-D MSM are alcohol, illicit drug use, sexual-enhancement medication, intentional condom nonuse, intention to use a condom, self-efficacy, attitudes toward condom use, perceived risk, perceived norms, perceived responsibility, treatment optimism, HIV medical management, social support, gay identity, mental health, compulsivity, trading sex, number of sex partners, and setting.

### **Individual Risk Correlates.**

#### ***Alcohol.***

Ten studies were included to examine the relation between alcohol use and UAI. Alcohol use was operationally defined differently among studies (e.g., number of drinks per occasion and proximity of alcohol consumption to anal intercourse). The effect was significant with zero falling outside the confidence interval,  $ES = 1.560, 95\% CI [1.281, 1.900] p < .001$ , indicating a relation between alcohol use and UAI. Tests of heterogeneity were non-significant for the effect

size  $Q(8) = 9.521$ ,  $p = .300$ ,  $I^2 = 15.975$ ,  $T^2 = 0.015$ . Given the non-significant heterogeneity among studies, moderator variables were not examined for this risk correlate. The fail-safe  $N$  for the overall effect size was 46 studies.

### ***Illicit drug use.***

Twenty-three studies were included to examine the relation between illicit drug use and UAI. Illicit drugs included were marijuana, crack/cocaine, ecstasy, butyl nitrate, Special K, crystal methamphetamine, anxiolytics, designer drugs, heroin, hallucinogens, and opiates. The effect was significant with zero falling outside the confidence interval,  $ES = 1.725$ , 95% CI [1.321, 2.253]  $p < .001$ , indicating a relation between illicit drug use and UAI. Tests of heterogeneity were significant for the effect size,  $Q(22) = 119.307$ ,  $p < .001$ ,  $I^2 = 81.560$ ,  $T^2 = 0.311$ . Given the significant heterogeneity among studies, moderator variables were examined. Both sex position and timeframe for assessing UAI significantly moderated the relationship between illicit drug use and UAI in HIV-D MSM ( $p < .001$  and  $p = .001$ , respectively). The fail-safe  $N$  for the overall effect size was 534 studies.

### ***Sexual enhancement medication.***

Five studies were included to examine the relation between sexual enhancement prescription medication (e.g., Viagra<sup>®</sup>) and UAI. Although the variable is a prescription medication, respondents did not necessarily have a valid prescription or experience sexual dysfunction. The effect was significant with zero falling outside the confidence interval,  $ES = 2.231$ , 95% CI [1.533, 3.245]  $p = .124$ , indicating a relation between sexual enhancement medication and UAI. Tests of heterogeneity were non-significant for the effect size,  $Q(4) = 7.225$ ,  $p < .001$ ,  $I^2 = 44.637$ ,  $T^2 = 0.078$ . Given the non-significant heterogeneity among studies,

moderator variables were not examined for this variable. The fail-safe  $N$  for the overall effect size was 41 studies.

***Intentional condom nonuse.***

Four studies were included to examine the relation between intentional condom nonuse and UAI. This variable set included identified barebackers as well as individuals who reported “deciding” to engage in condomless sex. The effect was significant with zero falling outside the confidence interval,  $ES = 4.585$ , 95% CI [3.784, 5.557]  $p < .001$ , indicating a relation between intentional condomless sex and UAI. Tests of heterogeneity were non-significant for the effect size,  $Q(3) = 3.046$ ,  $p = .385$ ,  $I^2 = 1.507$ ,  $T^2 = 0.001$ . Given the non-significant heterogeneity among studies, moderator variables were not examined for this variable. The fail-safe  $N$  for the overall effect size was 186 studies.

***Intention to use a condom.***

Five studies were included to examine the relation between intention to use a condom and UAI. The effect was non-significant with zero falling within the confidence interval,  $ES = 0.471$ , 95% CI [0.178, 1.248]  $p = .130$ , indicating no relation between intention to use condoms and UAI. Tests of heterogeneity were significant for the effect size,  $Q(4) = 117.373$ ,  $p < .001$ ,  $I^2 = 96.595$ ,  $T^2 = 1.099$ . Given the significant heterogeneity among studies, moderator variables were examined. Data collection year, sex position, and timeframe for assessing UAI significantly moderated the relationship between intention to use condoms and condom use in HIV-D MSM ( $p < .001$ ,  $p = .015$ , and  $p = .006$ , respectively).

### ***Self-efficacy.***

Nine studies were included to examine the relation between self-efficacy and UAI. Within HIV literature, self-efficacy refers to one's belief and confidence that they can effectively use condoms during sex. The effect was significant with zero falling outside the confidence interval,  $ES = 0.351$ , 95% CI [0.198, 0.620]  $p < .001$ , indicating a negative relation between self-efficacy and UAI. Tests of heterogeneity were significant for the effect size,  $Q(8) = 140.425$ ,  $p < .001$ ,  $I^2 = 94.303$ ,  $T^2 = 0.666$ . Given the significant heterogeneity among studies, moderator variables were examined. Age, data collection date, partner type, sex position, and timeframe for assessing UAI significantly moderated the relation between self-efficacy and UAI in HIV-D MSM ( $p = .017$ ,  $p = .002$ ,  $p = .049$ ,  $p < .001$ ,  $p < .001$ , respectively). The fail-safe  $N$  for the overall effect size was 292 studies.

### ***Attitudes toward condom use.***

Five studies were included to examine the relation between one's attitudes toward condom use (e.g., "condoms reduce my enjoyment of sex") and UAI. The effect was significant with zero falling outside the confidence interval,  $ES = 2.250$ , 95% CI [1.518, 3.337]  $p < .001$ , indicating a relation between attitudes toward condom use and UAI. Tests of heterogeneity were non-significant for the effect size,  $Q(4) = 5.466$ ,  $p = .243$ ,  $I^2 = 26.817$ ,  $T^2 = 0.056$ . Given the non-significant heterogeneity among studies, moderator variables were not examined for this variable. The fail-safe  $N$  for the overall effect size was 31 studies.

### ***Perceived risk.***

Seven studies were included to examine the relation between one's perceived risk (e.g., "because of progress made in developing new HIV vaccines, HIV-negative men do not need to be as worried about getting HIV"), for contracting HIV and UAI. Perceived risk A non-



significant effect was observed, with zero falling within the confidence interval,  $ES = 1.066$ , 95% CI [0.564, 2.014]  $p = .844$ . Tests of heterogeneity were significant for the effect size,  $Q(6) = 67.855$ ,  $p < .001$ ,  $I^2 = 91.158$ ,  $T^2 = 0.612$ . Given the significant heterogeneity among studies, moderator variables were examined. Partner type significantly moderated the relation between perceived risk and UAI in HIV-D MSM ( $p < .001$ ).

### ***Perceived norms.***

Six studies were included to examine the relation between one's perceived norms for condom use (e.g., "most people I know use condoms") and UAI. A non-significant effect was observed, with zero falling within the confidence interval,  $ES = 1.284$ , 95% CI [0.721, 2.285]  $p = .396$ . Tests of heterogeneity were significant for the effect size,  $Q(5) = 87.569$ ,  $p < .001$ ,  $I^2 = 94.290$ ,  $T^2 = 0.445$ . Given the significant heterogeneity among studies, moderator variables were examined. Data collection date, partner type, partner serostatus, and timeframe for assessing UAI significantly moderated the relation between perceived norms and UAI in HIV-D MSM ( $p < .001$ ,  $p < .001$ ,  $p = .012$ ,  $p = .034$ , respectively).

### ***Perceived responsibility.***

Five studies were included to examine the relation between one's perceived responsibility for condom use (e.g., "HIV-positive gay men have a responsibility to keep other gay men from becoming positive") and UAI. A non-significant effect was observed, with zero falling within the confidence interval,  $ES = 0.804$ , 95% CI [0.521, 1.240]  $p = .324$ . Tests of heterogeneity were significant for the effect size,  $Q(4) = 21.933$ ,  $p < .001$ ,  $I^2 = 81.763$ ,  $T^2 = 0.190$ . Given the significant heterogeneity among studies, moderator variables were examined. Timeframe for assessing UAI significantly moderated the relation between perceived responsibility and UAI in HIV-D MSM ( $p = .004$ ).

### ***Treatment optimism.***

Five studies were included to examine the relation between one's treatment optimism (e.g., "HAART reduces my susceptibility to transmit HIV") and UAI. A non-significant effect was observed, with zero falling within the confidence interval ES = 1.305, 95% CI [0.973, 1.749]  $p = .075$ . Tests of heterogeneity were significant for the effect size,  $Q(4) = 35.943, p < .001, I^2 = 88.871, T^2 = 0.080$ . Given the significant heterogeneity among studies, moderator variables were examined. Data collection date and timeframe for assessing UAI significantly moderated the relation between treatment optimism and UAI in HIV-D MSM ( $p < .001$ ).

### ***HIV medical management.***

Six studies were included to examine the relation between HIV medical management and UAI. This variable type includes information about CD4 count, viral load, and whether the respondent was taking HAART at the time of data collection. A non-significant effect was observed, with zero falling within the confidence interval, ES = 0.986, 95% CI [0.575, 1.690]  $p = .958$ . Tests of heterogeneity were significant,  $Q(5) = 12.845, p = .025, I^2 = 61.074, T^2 = 0.252$ . Given the significant heterogeneity among studies, moderator variables were examined; however, none of the moderator variables included accounted for the heterogeneity, as they all resulted in  $p$  values greater than 0.05.

### ***Social support.***

Five studies were included to examine the relation between social support (e.g., "I can count on my friends when things go wrong.") and UAI. The effect was significant with zero falling outside the confidence interval, ES = 0.861, 95% CI [0.748, 0.992]  $p = .038$ , indicating a negative relation between social support and UAI. Tests of heterogeneity were significant for the effect size,  $Q(4) = 14.982, p = .005, I^2 = 73.301, T^2 = 0.015$ . Given the significant

heterogeneity among studies, moderator variables were examined. Partner type and partner serostatus significantly moderated the relation between self-efficacy and UAI in HIV-D MSM ( $p = .027$  and  $p = .001$ , respectively). The fail-safe  $N$  for the overall effect size was 13 studies.

### ***Gay identity.***

Five studies were included to examine the relation between one's self-identification as gay (rather than bisexual, heterosexual, or "other") and UAI. A significant effect was observed, with zero falling outside the confidence interval,  $ES = 1.582$ , 95% CI [1.092, 2.292]  $p = .015$ . Tests of heterogeneity were non-significant,  $Q(4) = 8.878$ ,  $p = .064$ ,  $I^2 = 54.946$ ,  $T^2 = 0.073$ . Given the non-significant heterogeneity among studies, moderator variables were not examined for this risk correlate. The fail-safe  $N$  for the overall effect size was 18 studies.

### ***Mental health.***

Thirteen studies were included to examine the relation between mental health (e.g., depression, social anxiety, loneliness) and UAI. A non-significant effect was observed, with zero falling within the confidence interval,  $ES = 1.068$ , 95% CI [0.903, 1.263]  $p = .444$ . Tests of heterogeneity were significant,  $Q(12) = 37.075$ ,  $p < .001$ ,  $I^2 = 67.633$ ,  $T^2 = 0.044$ . Given the significant heterogeneity among studies, moderator variables were examined. Sex position significantly moderated the relation between mental health and UAI in HIV-D MSM ( $p = .026$ ).

### ***Compulsivity***

Five studies were included to examine the relation between compulsivity (e.g., "in the past three months, how often have you had trouble controlling your sexual urges?") and UAI. A significant effect was observed, with zero falling outside the confidence interval,  $ES = 1.846$ , 95% CI [1.166, 2.922]  $p = .009$ . Tests of heterogeneity were significant,  $Q(4) = 62.531$ ,  $p <$

.001,  $I^2 = 93.603$ ,  $T^2 = 0.463$ . Given the significant heterogeneity among studies, moderator variables were examined. Data collection date significantly moderated the relation between compulsivity and UAI in HIV-D MSM ( $p < .001$ ). The fail-safe  $N$  for the overall effect size was 93 studies.

***Traded or paid for sex.***

Three studies were included to examine the relation between an individual endorsing that they had traded (drugs) or paid for sex and UAI. A significant effect was observed, with zero falling outside the confidence interval,  $ES = 2.340$ , 95% CI [1.563, 3.503]  $p < .001$ . Tests of heterogeneity were non-significant,  $Q (2) = 2.098$ ,  $p = .350$ ,  $I^2 = 4.663$ ,  $T^2 = 0.009$ . Given the non-significant heterogeneity among studies, moderator variables were not examined for this risk correlate. The fail-safe  $N$  for the overall effect size was seven studies.

***Number of sex partners.***

Seven studies were included to examine the relation between the number of sexual partners reported within the observed timeframe and UAI. A significant effect was observed, with zero falling outside the confidence interval,  $ES = 1.578$ , 95% CI [1.129, 2.207]  $p = .008$ . Tests of heterogeneity were significant,  $Q (6) = 164.44$ ,  $p < .001$ ,  $I^2 = 96.342$ ,  $T^2 = 0.156$ . Given the significant heterogeneity among studies, moderator variables were examined. Age, location, data collection date, and sex position significantly moderated the relation between number of sex partners and UAI in HIV-D MSM (each at  $p < .001$ ). The fail-safe  $N$  for the overall effect size was 140 studies.

### ***Setting.***

Five studies were included to examine the relation between the setting in which a partner was found (e.g., internet, bathhouse) or location of sex (e.g., public place) and UAI. A non-significant effect was observed, with zero falling within the confidence interval,  $ES = 1.616$ , 95% CI [0.993, 2.631]  $p = .054$ . Tests of heterogeneity were significant for the effect size,  $Q(4) = 14.101$ ,  $p = .007$ ,  $I^2 = 71.634$ ,  $T^2 = 0.187$ . Given the significant heterogeneity among studies, moderator variables were examined. Age, data collection date, and timeframe for assessing UAI, significantly moderated the relationship between setting and UAI in HIV-D MSM ( $p = .006$ ,  $p = .037$ , and  $p = .031$ , respectively).

### **Information-Motivation-Behavioral Skills Model.**

#### ***Information.***

Of the 50 studies that included outcome data for the relation between a psychosocial variable and UAI in a sample of HIV-D MSM, none included results relevant to the Information IMB category (i.e., measures of knowledge about HIV). Because the number of studies included with an Information variable was less than three, meta-analysis was deemed inappropriate, as a fail-safe  $N$  could not be calculated.

#### ***Motivation.***

The Motivation category of the IMB Model includes variables assessing one's perceptions and attitudes related to various aspects of risk and preference of sexual behavior (Fisher & Fisher, 1992). Of the 50 studies that included outcome data for HIV-D MSM, 23 were included for meta-analysis of Motivation-related risk. Correlate types included were anticipated regret, attitudes toward condom use, perceived norms, perceived responsibility, perceived risk,

temptation, and treatment optimism. The effect was significant with zero falling outside the confidence interval,  $ES = 1.255$ , 95% CI [1.048, 1.503]  $p = .014$ , indicating a relation between Motivation variables and UAI. Tests of heterogeneity were significant for the effect size,  $Q (22) = 210.476$ ,  $p < .001$ ,  $I^2 = 89.547$ ,  $T^2 = 0.126$ . Given the significant heterogeneity among studies, moderator variables were examined. Location, partner type, partner serostatus, and timeframe for assessing UAI moderated the relation between Motivation variables and UAI in HIV-D MSM ( $p = .012$ ,  $p < .001$ ,  $p = .004$ ,  $p < .001$ , respectively). The fail-safe  $N$  for the overall effect size was 96 studies. Forest plots for outcomes of Motivation variables in MSM-D are displayed in Figure 3.

### ***Behavioral Skills.***

The Behavioral Skills category of the IMB Model includes variables assessing one's primary (e.g., engaging in UAI) and secondary behaviors (e.g., sex under the influence of a substance) related to potential sexual risk (Fisher & Fisher, 1992). Of the 50 studies that included outcome data for HIV-D MSM, 33 were included for meta-analysis of Behavioral Skills-related risk. Correlate types included alcohol, illicit drug use, intentional condom nonuse, intention to use a condom, number of partners, and self-efficacy. A non-significant effect was observed, with zero falling within the confidence interval,  $ES = 1.240$ , 95% CI [0.912, 1.685]  $p = .169$ . Tests of heterogeneity were significant for the effect size,  $Q (32) = 454.069$ ,  $p < .001$ ,  $I^2 = 92.953$ ,  $T^2 = 0.688$ . Given the significant heterogeneity among studies, moderator variables were examined. Sex position, partner serostatus, and timeframe for assessing UAI significantly moderated the relationship between setting and UAI in HIV-D MSM ( $p < .001$ ,  $p = .011$ , and  $p < .001$ , respectively). Forest plots for outcomes of Behavioral Skills variables in MSM-D are displayed in Figure 4.

## **HIV-nondiagnosed MSM**

Thirty-six studies were included to examine the global relation between psychosocial risk correlates and UAI. The effect was significant with zero falling outside the confidence interval,  $ES = 1.335$ , 95% CI [1.216, 1.465]  $p < .001$ , indicating a relation between psychosocial risk factors and UAI. As would be expected, given the range of variables included in this global analysis, tests of heterogeneity were significant for the effect size,  $Q(35) = 243.949$ ,  $p < .001$ ,  $I^2 = 85.653$ ,  $T^2 = 0.035$ . Given the significant heterogeneity among studies, moderator variables were examined. Age, data collection date, and timeframe for assessing UAI, significantly moderated the relationship between global risk correlates and UAI in HIV-ND MSM ( $p < .001$ ,  $p = .040$ , and  $p < .001$ , respectively). The fail-safe  $N$  for the overall effect size was 843 studies. Figure 5 provides a summary of forest plots for studies included for the subgroup of HIV-ND MSM.

Among these 36 studies, 29 included outcome data that could be grouped with at least two other studies' data for meta-analysis. A criterion for inclusion as a "correlate type" was a minimum of three studies examining a particular variable, to satisfy requirements for calculation of a fail-safe  $N$  within the CMA program. Risk correlates included for independent meta-analysis in HIV-ND MSM are alcohol, illicit drug use, intentional condom nonuse, attitudes toward condom use, perceived risk, perceived norms, social support, gay identity, mental health, trading sex, number of sex partners, and setting.

## **Individual Risk Correlates.**

### ***Alcohol.***

Nine studies were included to examine the relation between alcohol use and UAI. Alcohol use was operationally defined differently among studies (e.g., number of drinks per occasion, identification as a “heavy alcohol user,” and having sex under the influence of alcohol). The effect was significant with zero falling outside the confidence interval,  $ES = 1.265$ , 95% CI [1.086, 1.472]  $p = .002$ , indicating a relation between alcohol use and UAI. Tests of heterogeneity were significant for the effect size,  $Q(8) = 17.570$ ,  $p = .025$ ,  $I^2 = 54.468$ ,  $T^2 = 0.020$ . Given the significant heterogeneity among studies, moderator variables were examined. Both location and timeframe for assessing UAI significantly moderated the relationship between alcohol and UAI in HIV-ND MSM ( $p = .001$  and  $p = .004$ , respectively). The fail-safe  $N$  for the overall effect size was 43 studies.

### ***Illicit drug use.***

Thirteen studies were included to examine the relation between illicit drug use and UAI. Illicit drugs included were marijuana, crack/cocaine, ecstasy, butyl nitrate, Special K, crystal methamphetamine, anxiolytics, LSD, and “club drugs.” The effect was significant with zero falling outside the confidence interval,  $ES = 1.441$ , 95% CI [1.246, 1.666]  $p < .001$ , indicating a relation between illicit drug use and UAI. Tests of heterogeneity were significant for the effect size,  $Q(12) = 30.889$ ,  $p = .001$ ,  $I^2 = 61.151$ ,  $T^2 = 0.029$ . Given the significant heterogeneity among studies, moderator variables were examined. Both data collection date and partner type during assessed incident of UAI significantly moderated the relationship between illicit drug use and UAI in HIV-ND MSM ( $p = .008$  and  $p = .016$ , respectively). The fail-safe  $N$  for the overall effect size was 208 studies.



### ***Intentional condom nonuse.***

Three studies were included to examine the relation between intention to engage in condomless sex and UAI. This variable set included identified barebackers as well as individuals who reported “deciding” to engage in condomless sex. The effect was significant with zero falling outside the confidence interval,  $ES = 2.438$ , 95% CI [1.172, 5.074]  $p = .017$ , indicating a relation between intention to engage in condomless sex and UAI. Tests of heterogeneity were significant for the effect size,  $Q(2) = 119.919$ ,  $p < .001$ ,  $I^2 = 98.332$ ,  $T^2 = 0.388$ . Given the significant heterogeneity among studies, moderator variables were examined. Data collection date and timeframe for assessing UAI significantly moderated the relationship between intention to engage in condomless sex and UAI in HIV-ND MSM ( $p = .045$  and  $p < .001$ , respectively). The fail-safe  $N$  for the overall effect size was 163 studies.

### ***Attitudes toward condom use.***

Three studies were included to examine the relation between attitudes toward condom use (e.g., “sex with condoms is my own personal decision”) and UAI. The effect was significant with zero falling outside the confidence interval,  $ES = 1.677$ , 95% CI [1.163, 2.416]  $p = .006$  indicating a relation between one’s attitudes toward condom use and UAI. Tests of heterogeneity were non-significant for the effect size  $Q(2) = 0.595$ ,  $p = .743$ ,  $I^2 < 0.001$ ,  $T^2 < 0.001$ . Given the non-significant heterogeneity among studies, moderator variables were not examined for this risk correlate. The fail-safe  $N$  for the overall effect size was only four studies.

### ***Perceived risk.***

Eight studies were included to examine the relation between perceived risk (e.g., “a strong immune system has kept me HIV negative”) and UAI. The effect was significant with zero falling outside the confidence interval,  $ES = 1.793$ , 95% CI [1.180, 2.734]  $p = .006$ ,

indicating a relation between perceived risk use and UAI. Tests of heterogeneity were significant for the effect size  $Q(7) = 72.784, p < .001, I^2 = 90.383, T^2 = 0.282$ . Given the significant heterogeneity among studies, moderator variables were examined. Partner type, sex position, and timeframe for assessing UAI significantly moderated the relationship between perceived risk and UAI in HIV-ND MSM (each at  $p < .001$ ). The fail-safe  $N$  for the overall effect size was 67 studies.

### ***Perceived norms.***

Three studies were included to examine the relation between perceived norms (e.g., “most of my friends think you should always wear a condom when having anal sex with a new partner”) and UAI. In a random effects model, a non-significant effect was observed, with zero falling within the confidence interval,  $ES < 0.958, 95\% CI [0.865, 1.060] p = .404$ . Tests of heterogeneity were significant,  $Q(2) = 35.431, p < .001, I^2 = 94.355, T^2 = 0.074$ . Given the significant heterogeneity among studies, moderator variables were examined; however, none of the moderator variables included accounted for the heterogeneity, as they all resulted in  $p$  values greater than 0.05.

### ***Social support.***

Four studies were included to examine the relation between social support and UAI. A non-significant effect was observed, with zero falling within the confidence interval,  $ES = 0.987, 95\% CI [0.974, 1.001] p = .065$ . Tests of heterogeneity were non-significant,  $Q(2) = 3.391, p = .335, I^2 = 11.543, T^2 < 0.001$ . Given the non-significant heterogeneity among studies, moderator variables were not examined for this risk correlate.

### ***Gay identity.***

Three studies were included to examine the relation between one's self-identification as gay (rather than bisexual, heterosexual, or "other") and UAI. A non-significant effect was observed, with zero falling within the confidence interval,  $ES = 1.484$ , 95% CI [0.715, 3.079]  $p = .289$ . Tests of heterogeneity were non-significant,  $Q(2) = 4.305$ ,  $p = .116$ ,  $I^2 = 53.544$ ,  $T^2 = 0.227$ . Given the non-significant heterogeneity among studies, moderator variables were not examined for this risk correlate.

### ***Mental health.***

Three studies were included to examine the relation between mental health (depression, emotional control, and anger) and UAI. A non-significant effect was observed, with zero falling within the confidence interval,  $ES = 1.055$ , 95% CI [0.940, 1.185]  $p = .363$ . Tests of heterogeneity were non-significant,  $Q(2) = 0.180$ ,  $p = .914$ ,  $I^2 < 0.001$ ,  $T^2 < 0.001$ . Given the non-significant heterogeneity among studies, moderator variables were not examined for this risk correlate.

### ***Traded or paid for sex.***

Three studies were included to examine the relation between an individual endorsing that they had traded (drugs) or paid for sex and UAI. A non-significant effect was observed, with zero falling within the confidence interval,  $ES = 1.452$ , 95% CI [0.764, 2.760]  $p = .255$ . Tests of heterogeneity were significant,  $Q(2) = 26.831$ ,  $p < .001$ ,  $I^2 = 92.546$ ,  $T^2 = 0.252$ . Given the significant heterogeneity among studies, moderator variables were examined. Age, location, data collection year, partner type, and timeframe for assessing UAI significantly moderated the relationship between having traded or paid for sex and UAI in HIV-ND MSM (each at  $p < .001$ ).

### ***Number of sex partners.***

Seven studies were included to examine the relation between the number of sexual partners within the observed timeframe and UAI. A non-significant effect was observed, with zero falling within the confidence interval,  $ES = 1.272$ , 95% CI [0.982, 1.647]  $p = .068$ . Tests of heterogeneity were significant,  $Q(6) = 53.100$ ,  $p < .001$ ,  $I^2 = 88.701$ ,  $T^2 = 0.069$ . Given the significant heterogeneity among studies, moderator variables were examined. Age, sex position, and partner serostatus significantly moderated the relationship between having traded or paid for sex and UAI in HIV-ND MSM ( $p = .004$ ,  $p = .001$ , and  $p = .001$ , respectively).

### ***Setting.***

Four studies were included to examine the relation between the setting in which a partner was found (e.g., internet, bathhouse) or location of sex (public place) and UAI. The effect was significant with zero falling outside the confidence interval,  $ES = 1.551$ , 95% CI [1.052, 2.289]  $p = .027$ , indicating a relation between setting and UAI. Tests of heterogeneity were significant for the effect size,  $Q(3) = 8.175$ ,  $p = .043$ ,  $I^2 = 63.305$ ,  $T^2 = 0.086$ . Given the significant heterogeneity among studies, moderator variables were examined. Age and timeframe for assessing UAI significantly moderated the relationship between setting and UAI in HIV-ND MSM ( $p = .027$  and  $p = .021$ , respectively). The fail-safe  $N$  for the overall effect size was 21 studies.

## **Information-Motivation-Behavioral Skills Model.**

### ***Information.***

Of the 35 studies that included outcome data for the relation between a psychosocial variable and UAI in a sample of HIV-ND MSM, only two results relevant to the Information

IMB category were presented (i.e., measures of knowledge about HIV). Because the number of studies included with an Information variable was less than three, meta-analysis was deemed inappropriate, as a fail-safe  $N$  could not be calculated.

### ***Motivation.***

The Motivation category of the IMB Model includes variables assessing one's perceptions and attitudes related to various aspects of risk and preference of sexual behavior (Fisher & Fisher, 1992). Of the 35 studies that included outcome data for HIV-ND MSM, 14 were included for meta-analysis of Motivation-related risk. Correlate types included were anticipated regret, attitudes toward condom use, perceived norms, perceived responsibility, perceived risk, temptation, and treatment optimism. The effect was significant with zero falling outside the confidence interval,  $ES = 1.514$ , 95% CI [1.306, 1.756]  $p < .001$ , indicating a relation between Motivation variables and UAI. Tests of heterogeneity were significant for the effect size,  $Q(13) = 150.851$ ,  $p < .001$ ,  $I^2 = 91.382$ ,  $T^2 = 0.037$ . Given the significant heterogeneity among studies, moderator variables were examined. Age, location, data collection date, partner type, and sex position moderated the relation between Motivation variables and UAI in HIV-ND MSM ( $p = .009$ ,  $p = .008$ ,  $p = .023$ ,  $p = .008$ , respectively). The fail-safe  $N$  for the overall effect size was 57 studies. Forest plots for outcomes of Motivation variables in MSM-D are displayed in Figure 6.

### ***Behavioral Skills.***

The Behavioral Skills category of the IMB Model includes variables assessing one's primary (e.g., engaging in UAI) and secondary behaviors (e.g., sex under the influence of a substance) related to potential sexual risk (Fisher & Fisher, 1992). Of the 35 studies that included outcome data for HIV-ND MSM, 22 were included for meta-analysis of Behavioral Skills-

related risk. Correlate types included alcohol, illicit drug use, intentional condom nonuse, intention to use a condom, and number of partners. Typically, self-efficacy for condom use would be included in this category; however, no studies reporting results for the relation between self-efficacy and UAI in a sample of HIV-ND were found. The effect was significant with zero falling outside the confidence interval,  $ES = 1.455$ , 95% CI [1.278, 1.655]  $p < .001$ , indicating a relation between Behavioral Skills variables and UAI. Tests of heterogeneity were significant for the effect size,  $Q(21) = 100.929$ ,  $p < .001$ ,  $I^2 = 79.193$ ,  $T^2 = 0.048$ . Given the significant heterogeneity among studies, moderator variables were examined. Partner type, and timeframe for assessing UAI each moderated the relation between Behavioral Skills variables and UAI in HIV-ND MSM ( $p = .012$  and  $p < .001$ , respectively). The fail-safe  $N$  for the overall effect size was 603 studies. Forest plots for outcomes of Behavioral Skills variables in MSM-N are displayed in Figure 7.

### **Summary of Meta-analytic Results**

Collectively, 37 separate meta-analyses were conducted. For HIV-D MSM, in addition to global assessment of the relation between psychosocial and behavioral correlates and UAI, 19 risk correlates were analyzed, and two meta-analyses of the IMB Model risk categories were conducted, resulting in a total of 22 separate meta-analyses. For HIV-ND MSM, a global assessment of risk also was conducted, 12 risk correlates were analyzed, and two meta-analyses of the IMB Model risk categories were conducted, resulting in a total of 15 separate meta-analyses.

## CHAPTER FOUR: DISCUSSION

The present study employed meta-analytic methods to elucidate psychosocial and behavioral correlates associated with UAI in HIV-D and HIV-ND MSM. Specifically, three goals were identified: determining the psychosocial and behavioral correlates significantly related to HIV risk in both HIV-D and HIV-ND MSM, calculating the strength of the relation between each variable and HIV risk within each group, and examining whether one category within the IMB Model resulted in variables with relatively stronger association with unsafe sex than others. Within each subgroup, several risk correlates were observed to be statistically significant in their relation to UAI. Additionally, for several of the risk factors, demographic (i.e., age, location) and descriptive (i.e., data collection date, operational definition of UAI) variables significantly moderated the strength of the relation. Moderator relationships of particular interest for this study were age and data collection date as they pertained to perceived risk. It was anticipated that outcomes from studies wherein data were collected after 2002 would reflect decreased concern about risk for contracting HIV. Similarly it was anticipated that younger MSM would be less concerned about HIV transmission than older MSM, thereby increasing younger MSM's risk behavior.

Of the 19 individual correlates assessed within the subgroup of HIV-D MSM, 11 were observed to be significantly related to UAI, with one additional correlate (i.e., setting) approaching significance. Those variables that achieved significant effect were alcohol, illicit drug use, sexual-enhancement medication, intentional condom nonuse, self-efficacy, attitudes toward condom use, social support, gay identity, compulsivity, trading sex, and number of sex partners. Those that were observed to be statistically non-significant were intention to use a condom, perceived risk, perceived norms, perceived responsibility, HIV medical management,

treatment optimism, mental health, and setting. Several of these risk factors fall within the Motivation and Behavioral Skills stages of the IMB Model.

With respect to the relation between having sex under the influence or in the context of alcohol and illicit drug use and condom nonuse in HIV-D MSM, findings of the present study are consistent with previous meta-analytic findings. Shuper, Joharchy, Irving, and Rehm (2009) examined the relation between alcohol as defined by any alcohol use, problematic alcohol use, and alcohol use in the context of sex, among people living with HIV. Samples included men and women of varying sexual orientation identification. Though separate analyses were not conducted for the MSM subgroups within their study, overall effects were significant for each of the three alcohol-related conditions. The present meta-analysis helps to corroborate and further their findings, specific to the subgroup of HIV-D MSM. Additionally, various illicit drugs have been examined to determine their relation to UAI. Despite the *a priori* risk increase that accompanies substance use, there is a dearth of synthesis within this body of literature. Results of the primary study reveal that primary studies overwhelmingly provide evidence for the relation between illicit drug use and UAI.

Whereas alcohol and illicit substance use alter an individual's mental state, likely contributing to both intentional and unintentional condom nonuse, recreational use of sexual enhancement drugs, especially Sildenafil (i.e., Viagra<sup>®</sup>) was popularized in gay circuit parties, a setting often associated with risky sex (Colfax et al., 2001). Although HIV-D MSM are at increased risk for erectile dysfunction (Ende, Lo, DiNubile, & Mounzer, 2006), recreational use of sexual enhancement medication has been linked to concurrent use of crystal methamphetamine in MSM (Fisher, Reynolds, Ware & Napper, 2011; Mansergh et al., 2006), further increasing risk.



In addition to various substances that are observed to contribute to increased risk for HIV transmission, intentional condom nonuse and self-efficacy were observed to differentially impact UAI. As expected, intentional condom nonuse, specifically identified as “barebacking” in most studies included, was significantly associated with UAI. As previously mentioned in the present study, strategies to reduce risk were observed as evidenced by the moderating impact of partner serostatus and sex position, which yielded a negative relationship between intentional condom nonuse and UAI when partner serostatus was known to be discordant and when the subject’s sex position was as the insertive partner. Among the group of barebackers included in the present study may also be the most high-risk subgroups of MSM, identified as “gift givers,” whose sexual behaviors are characterized by intentional UAI without attempts to minimize transmission risk in an effort to spread the “gift” of HIV (Gauthier & Forsyth, 1999). An ethnographic analysis of one website dedicated to barebacking revealed that 26% of users identified as gift givers on their profiles (Groves & Parsons, 2006). Best practice for prevention of further HIV transmission likely would include assessment of whether an individual identifies as a barebacker or gift giver, to tailor treatment accordingly to address variables (e.g., substance use during sex, low perceived risk) that may be contributing to UAI behavior.

Unlike intentional condom nonuse which, unsurprisingly, was significantly associated with UAI, self-efficacy was observed to have a significant negative relation to UAI, suggesting that the more confident an individual reported to be in his ability to use a condom, the less likely he was to engage in UAI. This observed effect was moderated, in part, by sex position. This finding suggests that, although HIV-D MSM who feel more confident in their ability to use a condom when they are the insertive partner, their confidence in their own condom use abilities does not necessarily translate to their ability to ask their partner to wear a condom when in the

receptive position. In addition to HIV-D MSM's confidence in their ability to use a condom effectively, men's more favorable attitudes toward condom use were negatively related to UAI. A combination of assessing and discussing HIV-P MSM's attitudes toward condoms and confidence in using them may be important components for prevention.

Gay identity and social support both were observed to significantly relate to UAI in HIV-D MSM. Gay identity was positively related to UAI, indicating that although the behavior is the same (i.e., condomless anal sex with a male partner), one's identity as gay is related to increased risk over those who identify as bisexual, heterosexual, or with another name. This finding has been linked with possible increased HIV and sexual identity stigma (Mutchler et al., 2008). Social support has been observed to negatively correlate with stigma for gay identity (Wohl et al., 2012). Social support was observed to have a negative relation to UAI and additionally has been linked to increased serodisclosure among HIV-D MSM (Latkin et al., 2012).

Compulsivity, trading sex, and number of sex partners each were observed to positively correlate with UAI in HIV-D MSM. Compulsivity has been associated with increased number of sex partners, among other variables (e.g., temptation to engage in condomless sex, barebacking identity, drug use during sex [Groves, Parsons, & Bimbi, 2010]). Similarly, the act of trading sex for money or drugs is seemingly compulsive and appears to be associated with increased sexual risk taking. It is logical that if a person is willing to pay or be paid for sex or trade sex for drugs, health concerns about condom use are less likely to be considered.

Variables observed to be not significantly related to UAI included intention to use a condom, perceived risk, perceived norms, perceived responsibility, HIV medical management, treatment optimism, mental health, and setting. Although intention to use a condom was not expected to positively correlate to UAI, it is meaningful to note that intention to use a condom

was not significantly negatively related to UAI, either. Additionally, several factors related to perception were observed to be not significantly related to UAI. These findings demonstrate differential outcomes of risk correlates, based on serostatus, as perceived risk was related to decreased UAI in HIV-ND MSM. HIV medical management (e.g., whether the subject is taking HAART, current viral load) and mental health variables both have been associated with UAI in HIV-D MSM in primary studies (Bouhnik et al. 2006; Hart, James, Purcell, & Farber, 2008; Nöstlinger et al., 2011.; Poppen, Reisen, Zea, Bianchi, & Echeverry, 2004; Semple, Patterson, & Grant, 2000); however, bivariate relations were not significant in the majority of primary studies. Findings of the current study with respect to non-significant relation between mental health variables are consistent with that of a meta-analysis examining the association between “negative affective states” and sexual risk (Crepaz, 2001). It may be that many correlates that are observed to have a non-significant bivariate relationship with UAI are part of a more complex multivariate association. For instance, depression (included in the present study as a “mental health” variable) has been observed to have a significant relation with risky sex, but the association is mediated by self-efficacy and cognitive escape (Alvy et al., 2011).

In addition to identifying risk correlates and quantitatively evaluating the strength of their relation to UAI in HIV-D MSM, the present study aimed to investigate categories of risk within the IMB Model. For HIV-D MSM, correlates falling within the Motivation stage were the only stage within the IMB Model observed to have a significant relation to UAI. Somewhat surprisingly, there was not a sufficient number of studies to conduct a meta-analysis on Information variables. Although some risk perception variables likely are associated with one’s knowledge of actual risk, the IMB Model clearly differentiates these stages, and the present study adhered to definitions and correlates defined by the originators of the model (Fisher &

Fisher, 1992). Findings that Motivation-related correlates were significantly associated with UAI when analyzed together, and Behavioral Skills-related correlates were not, were somewhat surprising. Evaluated as individual correlates, such variables were nearly all significant (except for intention to use a condom), whereas several of the Motivation-related correlates were observed to have a non-significant relation to UAI. This observed overall effect of Motivation correlates is somewhat contradictory to recent meta-analytic findings that Motivational Interviewing, a treatment approach that seeks to increase motivation to initiate and maintain a behavioral change, has null effects for increasing condom use in MSM (Berg, Ross, & Tikkanen, 2011). However, it is unclear from the study whether differential outcomes based on serostatus or on actual change to reported motivation level were observed.

Of the 12 individual correlates assessed within the subgroup of HIV-ND MSM, six were observed to be significantly related to UAI. Those variables that achieved significant effect were alcohol, illicit drug use, intentional condom nonuse, attitudes toward condom use, perceived risk, and setting. Those that were observed to be statistically non-significant were perceived norms, social support, gay identity, mental health, trading sex, and number of sex partners. Several of these risk factors fall within the Motivation and Behavioral Skills stages of the IMB Model.

As was the case for HIV-D MSM, alcohol and illicit drug use were significantly related to UAI in HIV-ND MSM. These findings also are consistent with those of a recent meta-review that examined the relation between alcohol and HIV risk in HIV-ND individuals (not specifically HIV-ND MSM [Shuper et al., 2010]). Similarly, a variety of drugs were included in analyses and resulted in significant effect. Alcohol and other substances consistently are found to be significantly correlated with UAI, though a causal effect has not been established (Shuper et al., 2010). As with several other risk correlates, it is likely that a complex relationship among

variables (e.g., drug use, compulsivity, younger age) contributes to the significant association between use of a mind-altering substance and UAI.

Intentional condom nonuse was observed to have a significant relation to UAI in HIV-ND MSM, as well as in HIV-D MSM. Again, this result is unsurprising as most men included in these studies identified as “barebackers.” Within the subculture of HIV-ND barebackers, is a much smaller minority, called “bug chasers,” who engage in intentional condom nonuse with the expressed purpose of contracting HIV. Bug chasers are the HIV-ND complement to gift givers and, similarly, do not make attempts to employ perceived risk reduction strategies (e.g., serosorting), as barebackers may (Groo & Parsons, 2006). Within the present sample, it appears that perceived risk reduction strategies (i.e., partner serostatus and sex position) did not affect the strength of the relation between intention and UAI, as timeframe for assessing UAI was the only significant moderator variable.

Attitudes toward condom use and perceived risk also were found to have significant effect on UAI in the present study. Attitudes toward condom use was observed to have significant effect in both HIV-D and HIV-ND MSM, as well as non-significant heterogeneity among included studies. Non-significant heterogeneity may be accounted for by the small number of studies included, which also may have contributed to a small fail-safe *N* (four studies) for this variable. Unlike outcomes for HIV-D MSM, perceived risk was observed to have significant association with UAI in HIV-ND MSM. This outcome seems logical in that contracting HIV may be perceived as the worst outcome (rather than re-infection, superinfection, or infecting a partner) when considering risks associated with sex. Therefore, perceived risk may serve as more of a deterrent for HIV-ND MSM than a hypothetical risk in an individual who has been diagnosed with HIV.

Finally, a significant effect was observed between the setting in which a partner was found (e.g., internet, bathhouse) or location of sex (e.g., public place) and UAI. Although this variable approached significance in HIV-D MSM ( $p = .054$ ), outcomes of the variable were similarly moderated by age and timeframe for assessing UAI in both subgroups. Age impacted the strength of the relation in HIV-ND MSM such that younger men who sought sexual partners online and in bathhouses were more likely to engage in UAI than older men. These findings are consistent with those of multivariate analyses that have identified younger age to be associated with increased risk behavior among HIV-ND MSM seeking sex partners via the internet (Klein & Tilley, 2012).

Variables observed to have non-significant effect on UAI in HIV-ND MSM were perceived norms, social support, gay identity, mental health, trading sex, and number of sex partners. Aside from mental health (which was not significantly related to UAI in HIV-D MSM) and perceived norms (which was not evaluated for HIV-D MSM), variables observed to have no significant relation to UAI in the subgroup of HIV-ND MSM were found to be significantly related to UAI in HIV-D MSM. This discrepancy is somewhat surprising, given number of sex partners is sometimes used as an outcome variable for risky sex (e.g., Li et al., 2012; Smoak, Scott-Sheldon, Johnson, & Carey, 2006). Further, trading sex is associated with other risk variables (e.g., illicit drug use), and therefore would have been expected to correlate with UAI. The non-significant effect of social support on UAI in HIV-ND MSM may be explained by differences in having social support specific to a positive serostatus, rather than a more general understanding of social support (Wohl et al., 2012).

In addition to identifying risk correlates and quantitatively evaluating the strength of their relation to UAI in HIV-ND MSM, the present study aimed to investigate categories of risk

within the IMB Model. For HIV-ND MSM, correlates falling within the Motivation and Behavioral Skills stages were observed to have a significant relation to UAI. Unfortunately, as was the case within the body of literature focused on HIV-D MSM, there was an insufficient number of studies examining Information-related to correlates for meta-analysis. Although both Motivation- and Behavioral Skills-related correlates were observed to have significant effect on UAI in HIV-ND MSM, their CI overlapped such that there was no significant difference between their observed associations with UAI. This finding illuminates the need for integration of these variables into prevention and intervention practice with HIV-ND MSM.

In addition to addressing the stated aims of the present study, two hypotheses were posited. The first hypothesis anticipated that data collection year would moderate the relationship between perceived risk and UAI. This hypothesis was not supported in HIV-D or in HIV-ND MSM. This finding is inconsistent with past meta-analytic findings that revealed an association between people's beliefs that HAART reduced their risk of contracting or transmitting HIV and increased UAI (Crepaz, Hart, & Marks, 2004). In the subgroup of HIV-D MSM, perceived risk did not yield a significant result with respect to its relation to UAI. As previously stated, this may be associated with decreased overall concern for risk once HIV has been contracted as compared to HIV-ND MSM, for whom perceived risk was significantly related to UAI. Despite that data collection year did not significantly moderate the strength of the relation of perceived risk with UAI, data collection year did significantly moderate the strength of the relation between several other variables and UAI. These findings are supported by evidence for increases in sexual risk behavior across age over time following the widespread availability of HAART, suggesting data collection date is an important factor in the relation between psychosocial and behavioral correlates and sexual risk behavior (Chen, Weide, & McFarland).

Similarly, the second hypothesis anticipated that age would significantly moderate the relation between perceived risk and UAI such that younger MSM would be more likely to engage in sexual risk behavior. This hypothesis was not supported, as age was not observed to significantly moderate the strength of its relation to UAI. Consistent with the outcome of data collection year, although age was not a significant moderating variable for perceived risk, age did significantly moderate the relation of several other risk correlates such that younger men appeared to be at increased risk. These overall findings are consistent with study results through the past three decades (Crepaz et al., 2000; Mansergh & Marks, 1998; Newcomb, 2013).

### **Limitations**

Meta-analysis can provide a useful method by which to quantitatively synthesize extant literature germane to a particular area of interest. Despite its utility, several criticisms of the meta-analytic approach exist. Additionally, limitations specific to this study were present.

Common criticisms of the meta-analytic method include concerns about publication bias (the “file drawer” problem) and combining studies that are so varied in their design and outcome that effects are meaningless. It is true that studies with statistically significant results are more likely to be published, which could result in Type I error occurring within a meta-analysis. However, the current study took measures to help reduce the probability of publication bias adversely affecting the validity of observed effects. First, the fail-safe  $N$  was used to provide an estimate of how many studies with null effects would be needed to render outcomes insignificant. Although some of the fail-safe  $N$  results were small enough to raise concern, nearly all of the effects would require several more studies than those with significant outcomes to nullify their effects. Further, the majority of the studies included in the present meta-analysis



included multiple outcomes and examined more than one correlate. These studies generally reported their non-significant findings, which were included in the present analysis.

Another common criticism of meta-analysis is that differences among included studies result in meaningless results. Unlike meta-analyses investigating treatment outcomes in randomized control trials, the present study was able to control the population to great extent by including only MSM of a specified serostatus. Additionally, demographic features and significant differences in measurement of the outcome variable (i.e., UAI) were examined as moderator variables when heterogeneity significantly impacted outcome.

Although measures were taken to address common concerns about meta-analytic methods, limitations specific to this study were present. First, the inclusion criterion requiring clear differentiation between a specified serostatus and a correlate with UAI was observed to be the most frequently violated, resulting in exclusion of more than twice as many studies as were included. This means that many more studies identifying a relation between a correlate and UAI have been published, conceivably with statistically significant results, but they were not included here. This increases the probability of Type II error, whereby effects that were observed to be non-significant in the present study actually may be significant within the larger population. Despite this, evaluating risk correlates specific to subgroups of MSM (HIV-D and HIV-ND) was deemed a valuable aim for the present study. Also, constraints of the criterion for bivariate outcomes may have oversimplified what likely are complicated relationships among variables resulting in increased risk for UAI. Further, the meta-analytic approach employed did not detect non-linear relationships among variables that may have been present.

Second, although a rigorous process was implemented by which to obtain all appropriate studies, the vast literature examining topics related to HIV risk factors and constraints of the

database used may have increased the probability that available studies were inadvertently excluded. Although references of included studies were examined and resulted in the inclusion of additional studies, it is quite possible that some studies were missed.

Finally, the iterative nature of the validity assessment and abstraction process resulted in changes to the originally proposed coding procedure. Whereas the initial plan was to calculate kappa coefficients for each item on the coding sheet, realities of complicated data presentation rendered the proposed coding procedure impractical. An attempt to incorporate “checks and balances” was made in light of the realization that validity assessment and data abstraction would not occur as initially intended, due to unforeseen complications with data presentation in primary studies. This plan included assessment of interrater and intrarater reliability of 25 percent of the articles further screened, weekly meetings with undergraduate coders, and weekly consultation with an expert statistician during the data abstraction phase. Despite these attempts to ensure accurate assessment and data abstraction, the process was not fully consistent with best practice; however, outlines for ideal coding procedures typically are aimed at meta-analyses focused on treatment outcomes, which likely have more direct presentation of data.

### **Clinical Implications and Future Directions**

Results of the present study have several clinical implications that may guide future prevention research and practice. First, the differential effects of correlates based on serostatus presented in this study provide evidence for the need for tailored intervention to these very different subgroups of MSM. For instance, results suggest that focused attention on increasing motivation may be of primary importance for prevention with HIV-D MSM, and integrated intervention of motivation and behavioral factors (e.g., decreasing substance use) may be more effective with HIV-ND MSM. The present meta-analysis excluded more than 300 studies for

reasons pertaining to unclear serostatus differentiation. When serostatus is assessed within a study examining risky sex or HIV correlates, it likely would be beneficial to treat the subgroups of HIV-D and HIV-ND as the unique populations that they appear to be, to increase the utility of findings for guiding prevention. If a goal of research investigating HIV risk factors is to contribute to understanding of best practice for prevention and intervention, then it is imperative that the subgroups of HIV-D and HIV-ND MSM be treated independently so that meaningful interpretations of findings can be made.

Second, future studies may benefit from consideration of results of the present meta-analysis to better understand complex, multivariate relations between risk variables and UAI. Exploring mediating and moderating variables in an effort to develop more comprehensive models of variable interactions could help to further develop extant knowledge about HIV risk factors and their complex association with UAI. For instance, intentional condom nonuse was treated as an independent “Behavioral Skills” variable in the present study, yet additional psychosocial variables (e.g., compulsivity, decreased perceived risk) likely mediate the relationship between barebacking identity and UAI. Elucidating the complexity of these relationships is a logical step toward more effective interventions, as constellations of related correlates likely account for a greater amount of variance than single variables. Further, given the differential relationships that independent variables have to HIV-D and HIV-ND MSM’s transmission risk behaviors, it is crucial that these relationships among variables be tested within specified serostatus samples.

Third, further assessing the impact of Information-based variables within subgroups of MSM may help to elucidate the impact of “knowing better” on reducing behavioral risk for contracting or transmitting HIV. Knowledge-based assessments have been found to negatively

correlate with UAI when evaluated in different populations both domestically and internationally (Benotsch, 2007; Fisher, 2012; Knox, Yi, Reddy, Maimane, & Sandfort, 2010; Nyoni & Ross, 2013). Although intuitively it is logical that dispelling myths and providing factual information about HIV transmission and condom use would, at the least, serve as a basis from which to increase one's motivation and behavioral skills to use condoms, it is unclear what role Information-related variables may play in reducing HIV transmission risk at this time. Without further evaluation of potentially differential effects of HIV knowledge on UAI in the subgroups of HIV-D and HIV-ND MSM, meaningful conclusions cannot be drawn about the utility of addressing this variable group in risk reduction interventions.

Finally, assessing variables shown to be associated with UAI in each subgroup of MSM may help to initiate a meaningful dialogue about these variables within a clinical setting. The state of evidence-based HIV transmission risk prevention services is such that incidence of HIV infection appears minimally impacted by treatment (Padian, McCoy, Balkus, Wasserheit, 2010; Ross, 2010), and researchers continue to investigate effective approaches to reducing risk in MSM. Results of a meta-analysis examining behavioral interventions for HIV transmission risk reduction suggest that an understanding of HIV incidence by age and sex is necessary for developing effective prevention programs for HIV-ND individuals, whereas understanding of HIV prevalence patterns are crucial to targeting interventions to reduce HIV transmission among HIV-D individuals (Ross, 2010).

Although interventions targeting behavioral skills have been among the most researched, Motivational Interviewing (MI) has been effectively employed to modify a range of substance use, health-related behaviors, treatment adherence, and gambling (see Lundahl, Kunz, Brownell, Tollefson, & Burke, 2010 for a meta-analytic review), more recently including HIV risk behavior

in MSM. As its name would suggest, MI seeks to modify behavior by increasing motivation for change (Miller & Rollnick, 2002). Despite its efficacy in various domains, a recent meta-analysis found that MI has a non-significant effect on increasing condom use in MSM (Berg, Ross, & Tikkanen, 2011). Thus, though Behavioral Skills variables were related to condom use in HIV-ND MSM and Motivation variables were related to condom use in both HIV-D and HIV-ND MSM, neither behavior- nor motivation-based interventions have been identified as “gold standard” for reducing incidence of HIV in MSM. One likely contributing factor is the complexity of relationships among risk variables in each population of MSM. Assessing these potential risk correlates and engaging in both collaborative clinical discussion, and in further intervention research, may result in more desirable outcomes than a “one size fits all” approach.

## **APPENDIX A: FIGURE 1**

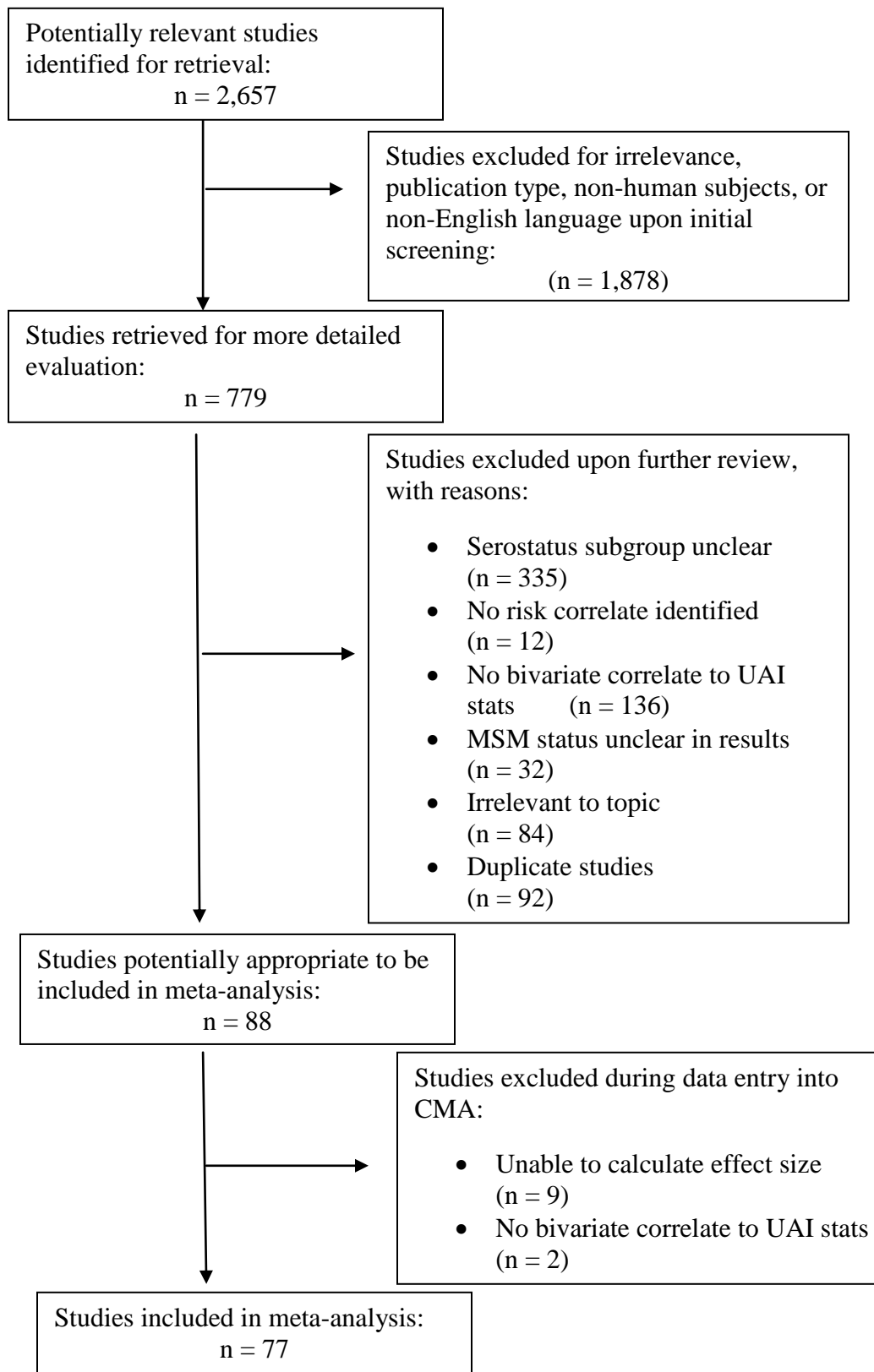


Figure 1: Progress through the Stages of Validity Assessment and Abstraction

## **APPENDIX B: FIGURE 2**



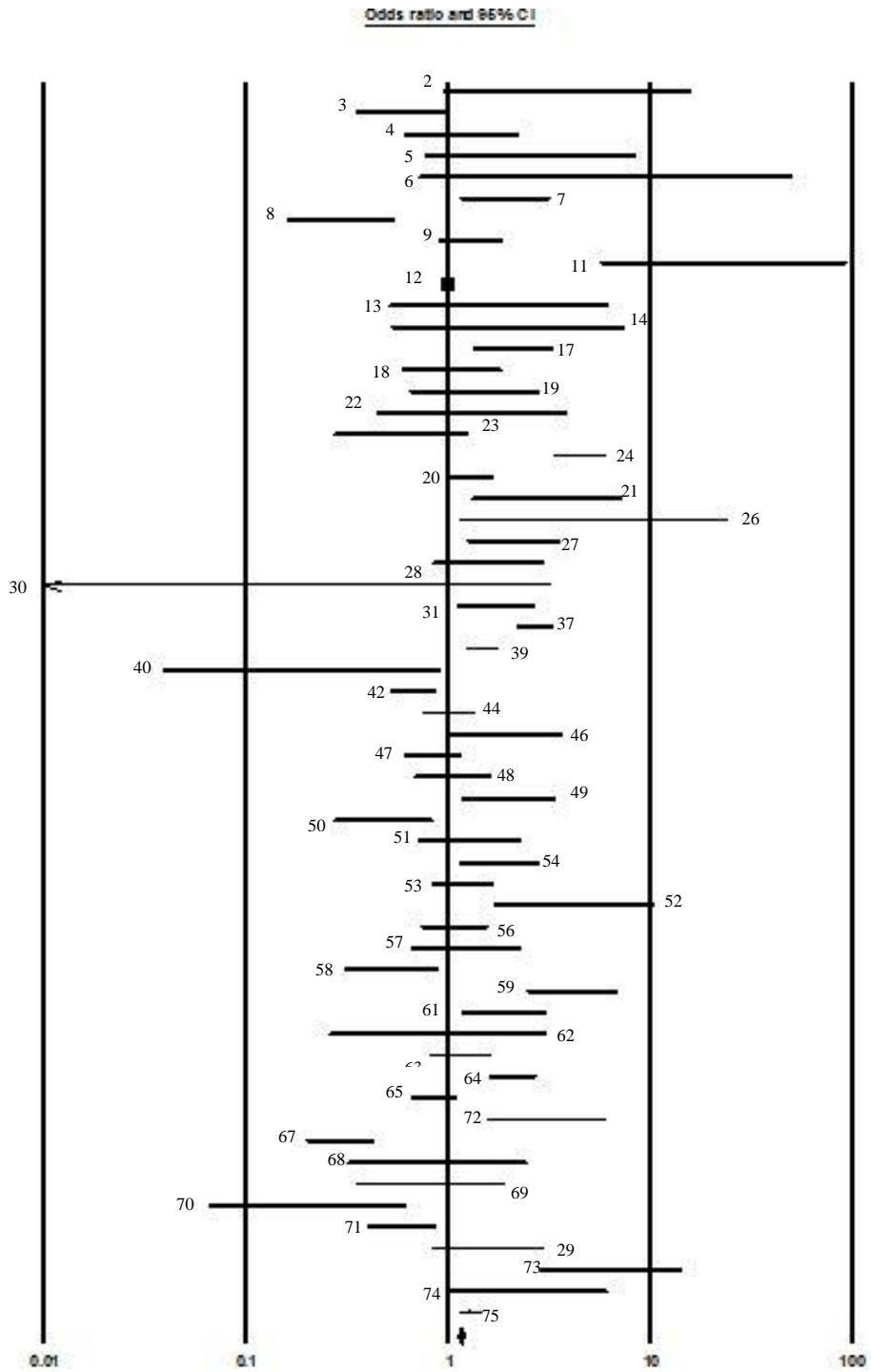


Figure 2: Forest Plots for Global Outcomes in HIV-D MSM

## **APPENDIX C: FIGURE 3**

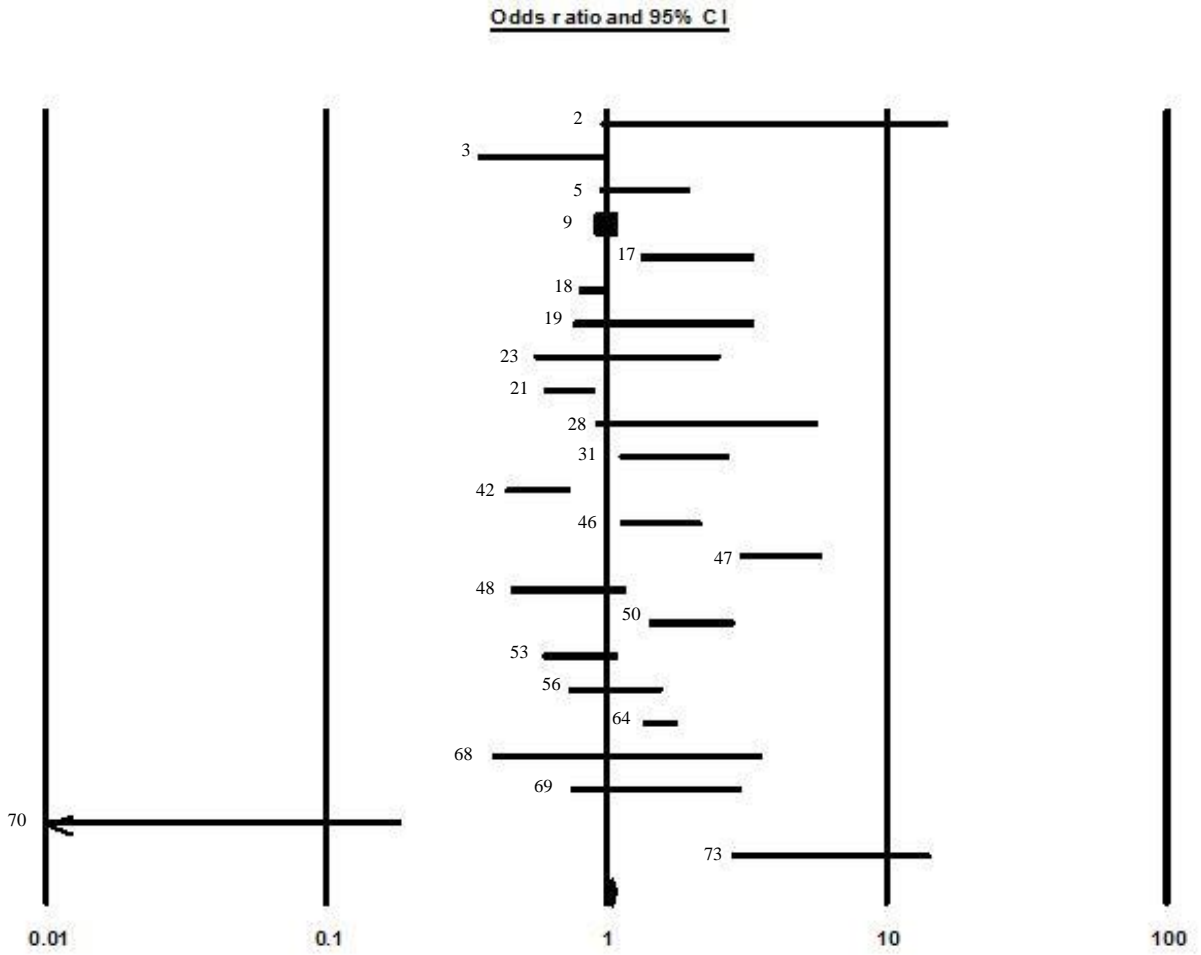


Figure 3: Forest Plots for Motivation Outcomes in HIV-D MSM

**APPENDIX D: FIGURE 4**

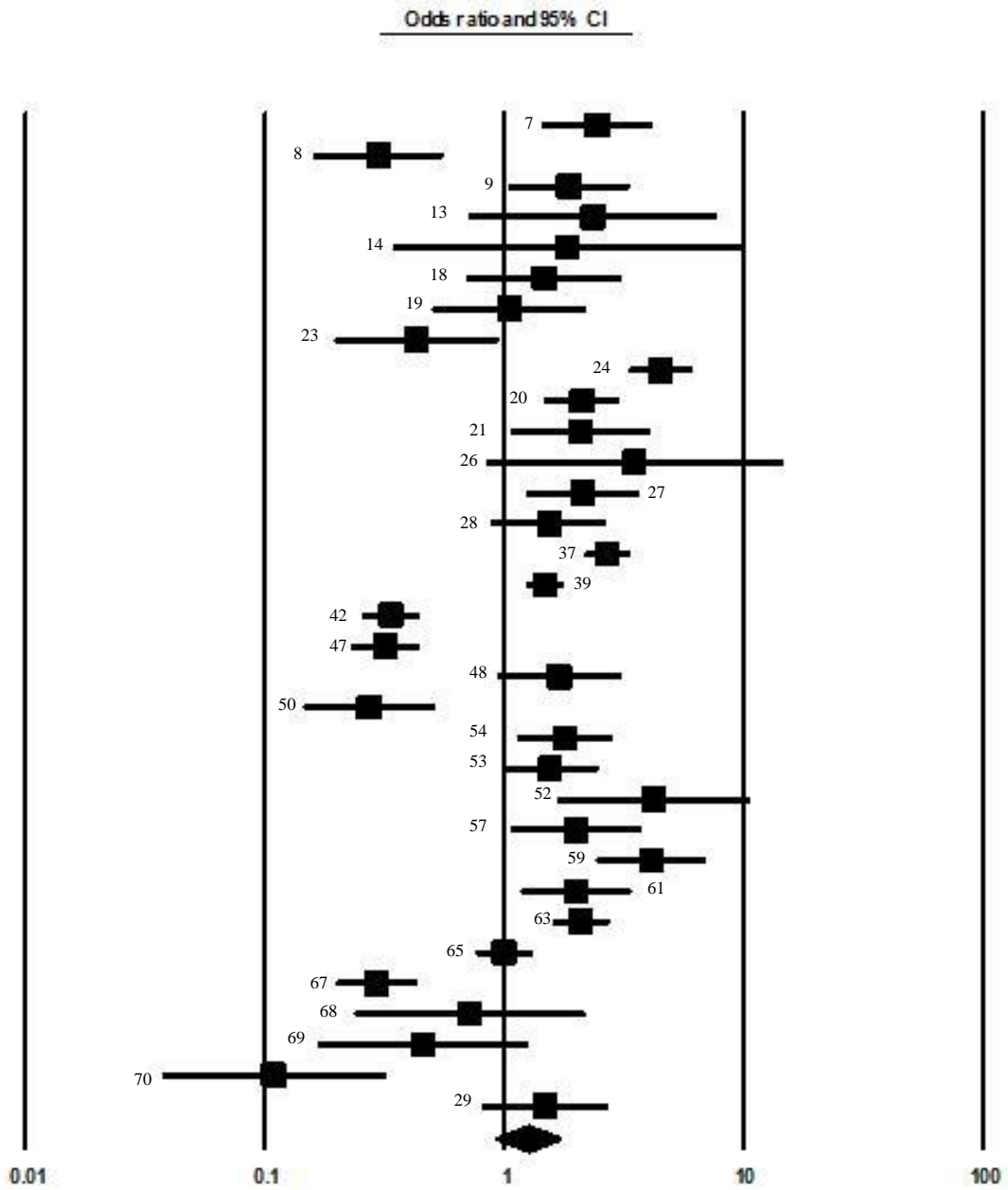


Figure 4: Forest Plots for Behavioral Skills Outcomes in HIV-D MSM

## **APPENDIX E: FIGURE 5**

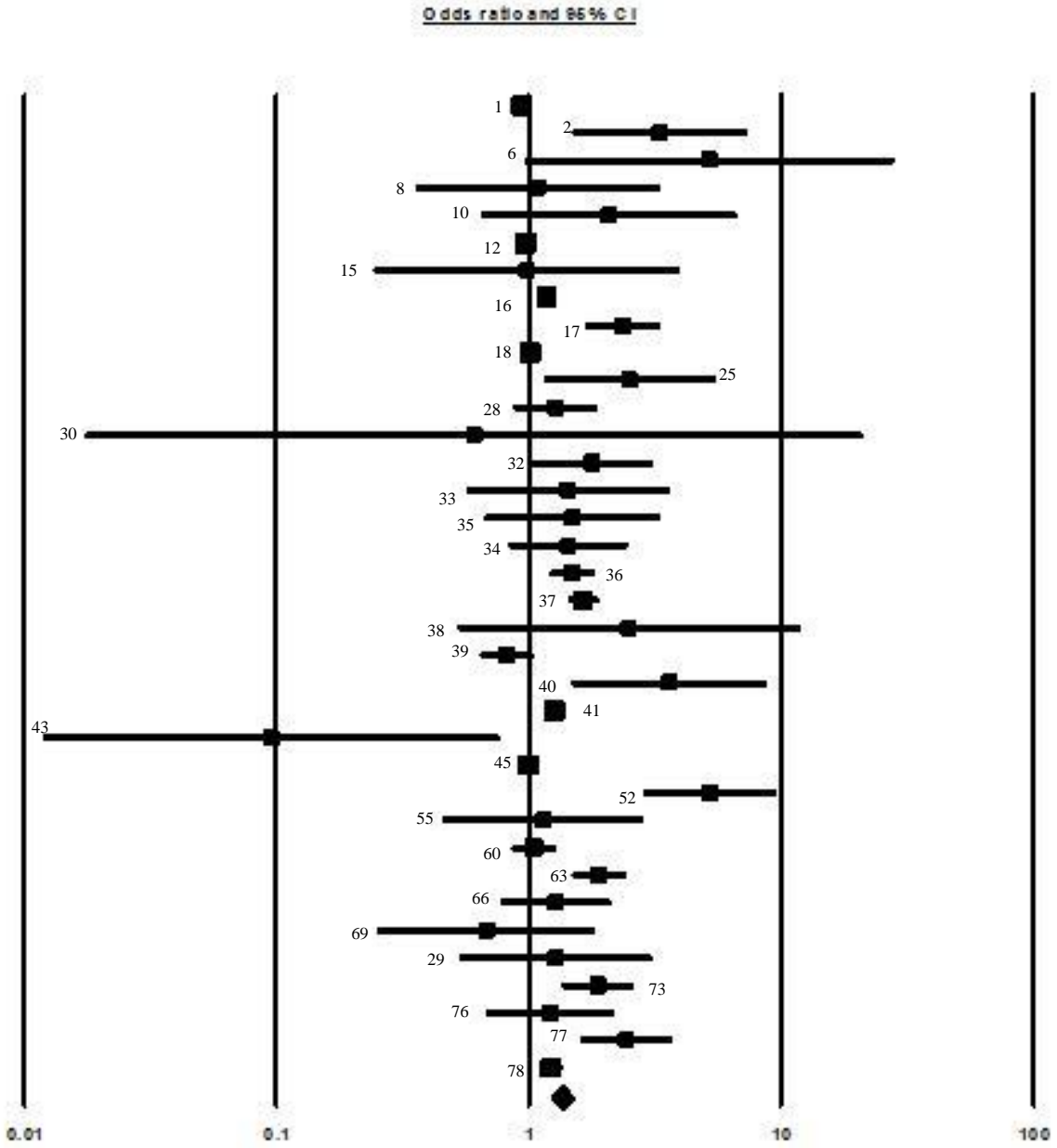


Figure 5: Forest Plots for Global Outcomes in HIV-ND MSM

**APPENDIX F: FIGURE 6**



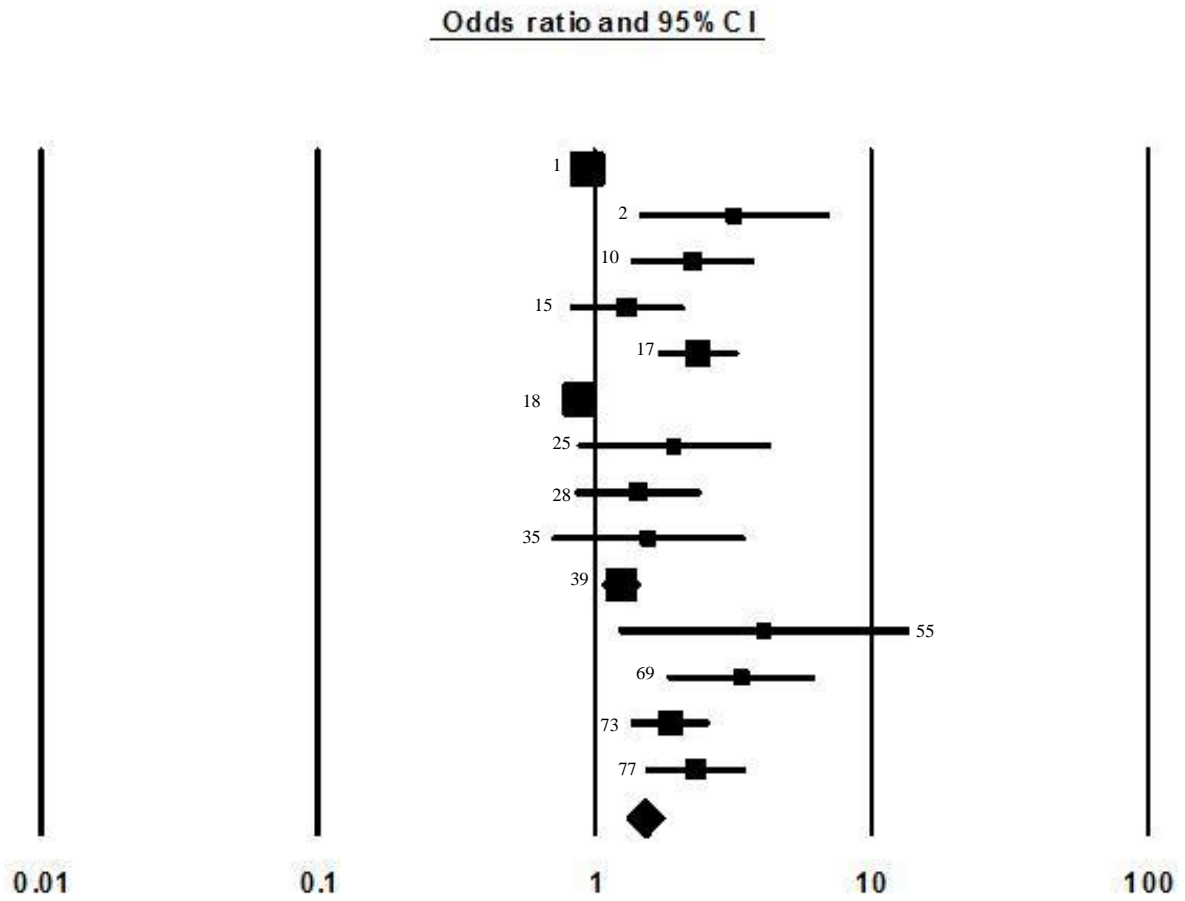


Figure 6: Forest Plots for Motivation Outcomes in HIV-ND MSM

## **APPENDIX G: FIGURE 7**

Odds ratio and 95% CI

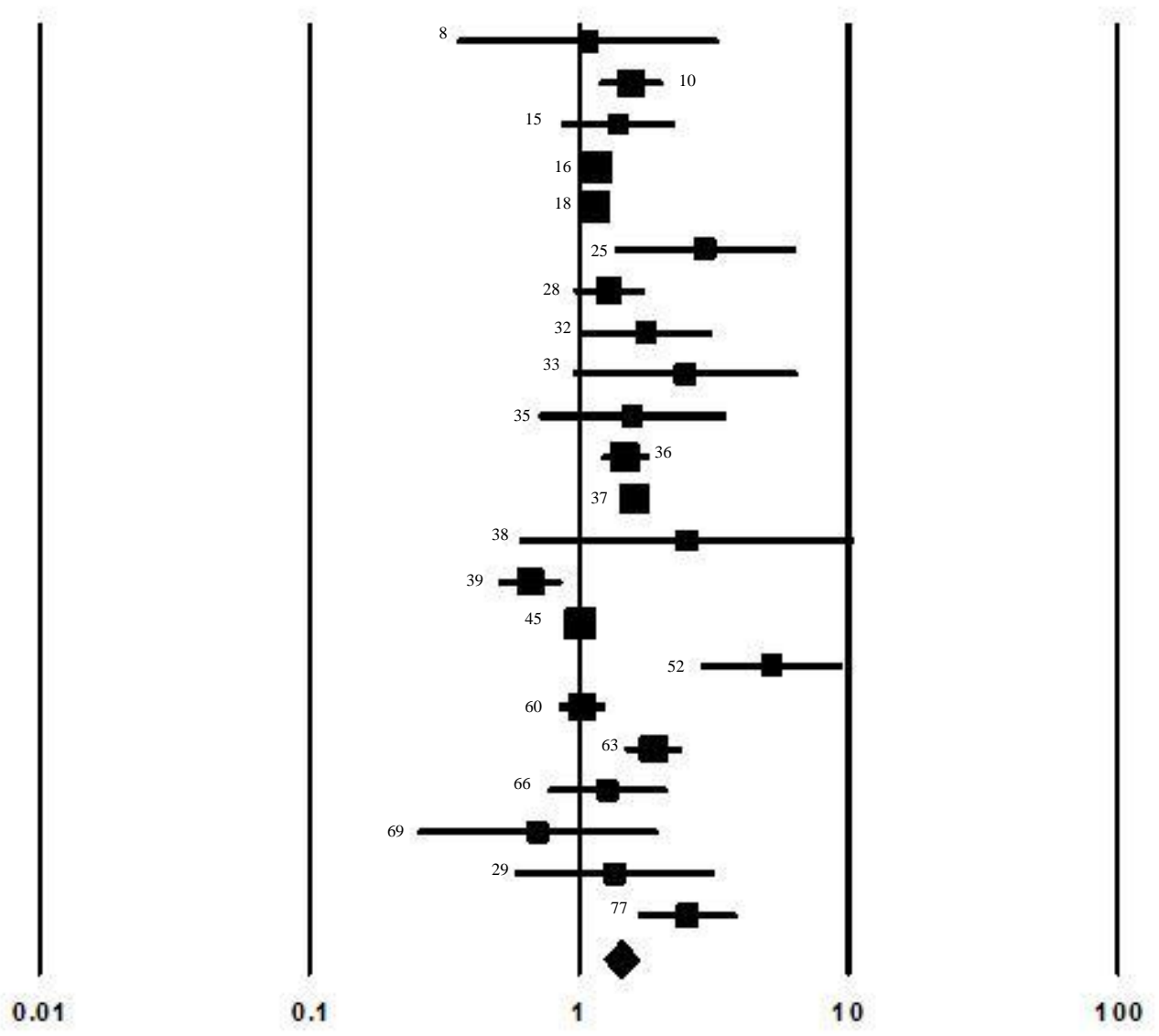


Figure 7: Forest Plots for Behavioral Skills Outcomes in HIV-ND MSM

**APPENDIX H: TABLE 1**

Table 1: Studies Included in Analyses with Descriptive Information

Study	Sub-population <sup>a</sup>	N	Correlate Type <sup>b</sup>	Age	Location	Data Collection Year	Operational Definition of UAI
<sup>1</sup> Appleby, Marks, Ayala, Miller, Murphy, & Mansergh (2005)	N	339	PR	<25 = 27.4% 25-30 = 37.2% 30-41 = 35.4%	US	1997	always UAI with a specific partner in past year; any UAI in past year; I-UAI with non-primary partner in past year; R-UAI with non-primary partner in past year
<sup>2</sup> Bauermeister, Carballo-Diéguez, Ventuneac, & Dolezal (2009)	B	120	AC; MH	$M = 33.57$ $SD = (9.63)$	unspecified	2005-2006	Number of R-UAI occasions in the past 2 months
<sup>3</sup> Belcher, Sternberg, Wolitski, Halkitis, & Hoff (2005)	D	174	PR	$M = 36.7$ $SD = (7.5)$	US	1997-1998	I-UAI in past 30 days
<sup>4</sup> Benotsch, Kalichman, & Pinkerton (2001)	D	203	C	$M = 40.5$ $SD = (7.4)$	unspecified	< 2002	Number of R-UAI acts in past 3 months
<sup>5</sup> Bingman, Marks, & Crepaz, (2001)	D	71	PR; D	Median = 37 (range 26 - 58)	US	<2002	UAI with seronegative/seronegative male in past 6 months
<sup>6</sup> Bolding, Davis, Hart, Sherr, & Elford (2005)	B	1181	S	Range = 18-63	non-US	2002-2003	Non-concordant UAI with casual partner in past 3 months; concordant UAI with casual partner in past 3 months
<sup>7</sup> Bouhnik, Préau, Schiltz, Peretti-Watel, Obadia, Lert, & Spire (2006)	D	591	P; I; S; A; MH	$M = 43$	non-US	2003	UAI with casual partner in past 12 months
<sup>8</sup> Bousman, Cherner, Ake, Letendre, Atkinson, Patterson, &... Everall (2009)	B	175	I	$M < 40$	US	unspecified	Percentage of time condom used
<sup>9</sup> Brennan, Welles, Miner, Ross, & Rosser (2010)	D	346	IH; TO; A; I; MH	Median = 43	US	unspecified	Serodiscordant UAI in past 3 months

Study	Sub-population <sup>a</sup>	N	Correlate Type <sup>b</sup>	Age	Location	Data Collection Year	Operational Definition of UAI
<sup>10</sup> Choi, Han, Hudes, & Kegeles (2002)	N	237	PN; D; P; GI	$M = 21$	US	1991	UAI in past 3 months
<sup>11</sup> Cove & Petrak (2004)	D	59	SD	20-29 = 15% 30-39 = 53% 40-49 = 25% 50-59 = 7%	non-US	2001	UAI in past year
<sup>12</sup> Darbes, Chakravarty, Beougher, Neilands, & Hoff (2012)	B	434	SS; RV	$M = 41.7$ $SD = (11.4)$	US	2005-2007	UAI with seroconcordant non-primary partner in past 3 months; UAI with serodiscordant/seroun known non-primary partner in past 3 months
<sup>13</sup> Darrow, Webster, Kurtz, Buckley, Patel, & Stempel (1998).	D	51	A; HM; D; BC; GI; I; K; MH	$M = 34$ $SD = 6.4$	US	1995	UAI in past 12 months
<sup>14</sup> Denning & Campsmith (2005)	D	664	I; GI; RV; TH	18-29 = 15% 30-39 = 51% 40-49 = 27% $\geq 50 = 7%$	US	1995-2000	UAI in past 12 months
<sup>15</sup> Dilley, McFarland, Sullivan, & Discepola (1998)	N	55	MH; AC; C; Kn; P; PRe; RV; SS; Tm	$M = 37$	US	< 2002	UAI in past 2 months
<sup>16</sup> Eaton, Kalichman, Cain, Cherry, Stearns, Amaral, & ... Pope (2007)	N	628	In	$M = 33$ $SD = 10$	US	2006	Mean number of R-UAI in past 6 months; mean number of I-UAI in past 6 months
<sup>17</sup> Elford, Bolding, & Sherr (2002)	B	2231	PR	Median = 33	non-US	1998-2001	UAI in past 3 months
<sup>18</sup> Forney & Miller (2012)	B	7416	D; I; PN; SS; TS	$M = 21.53$ $SD = (2.26)$	US	1999-2002	UAI in past 3 months
<sup>19</sup> Godin, Savard, Kok, Fortin, & Boyer (1996)	D	94	IC; AC; PN; PBC; PRe; MH; A; I	$M = 35.8$ $SD = (7.8)$	non-US	1991-1992	UAI in past 3 months
<sup>20</sup> Halkitis, Green, Remien, Stirratt, Hoff, Wolitski, & Parsons (2005)	D	1166	I; MH; PR; C; He	unspecified	US	1999-2002	Seroconcordant UAI in past 3 months

Study	Sub-population <sup>a</sup>	N	Correlate Type <sup>b</sup>	Age	Location	Data Collection Year	Operational Definition of UAI
<sup>21</sup> Halkitis, Green, & Wilton (2004)	D	114	I; SD	unspecified	unspecified	unspecified	I-UAI with seropositive partner in past 3 months; I-UAI with seronegative or serounknown in past 3 months; R-UAI with seropositive partner in past 3 months; R-UAI with seronegative or serounknown in past 3 months; frequency of I-UAI with seropositive partner in past 3 months; frequency of I-UAI with seronegative or serounknown in past 3 months; frequency of R-UAI with seropositive partner in past 3 months; frequency of R-UAI with seronegative or serounknown in past 3 months
<sup>22</sup> Halkitis & Parsons (2003)	D	64	AD; C; D; HM; IH; Ma; TH;	$M = 41.98$ $SD = 6.86$ range = 27-57	both	< 2002	Intentional seroconcordant and serodiscordant UAI in past 3 months
<sup>23</sup> Halkitis, P. N., Wilton, L. ., Parsons, J. T., & Hoff, C. C. (2004)	D	91	MH; PR; IC; Te; RV; SE; AF; AC; HM;	$M = 38$ $SD = 7.5$ range = 22-56	US	1997-1998	UAI in past 3 months

Study	Sub-population <sup>a</sup>	N	Correlate Type <sup>b</sup>	Age	Location	Data Collection Year	Operational Definition of UAI
			In				
<sup>24</sup> Halkitis, Wilton, Wolitski, Parsons, Hoff, & Bimbi (2005)	D	1440	In	$M = 41$ $SD = 7.91$	US	1999-2002	I-UAI with seropositive partner in past 3 months; I-UAI with seronegative or serounknown in past 3 months; R-UAI with seropositive partner in past 3 months; R-UAI with seronegative or serounknown in past 3 months
<sup>25</sup> Halkitis, Zade, Shrem, & Marmor (2004)	N	94	I; PR	$M = 39$ $SD = 10.73$ range = 20–70	US	unspecified	R-UAI with seronegative/serounknown casual partners in the past 4 months
<sup>26</sup> Hart, James, Purcell, & Farber (2008)	D	84	I; MH; To	$M = 41.9$ $SD = 6.6$	US	2002-2003	I-UAI with seronegative/serounknown partner in past 6 months; R-UAI with seronegative/serounknown partner in past 6 months
<sup>27</sup> Hatfield, Horvath, Jacoby, & Rosser (2009)	D	675	A; I	$M = 42$ $SD = 8.2$	US	unspecified	Serodiscordant UAI in the past year
<sup>28</sup> Hays, Paul, Ekstrand, Kegeles, Stall, & Coates (1997)	B	311	D; A; GI; RV; P; C; AC; PN; SS; SE; IB; SC	$M = 25.83$ $SD = 2.52$ range = 18-29	US	< 2002	UAI in past 12 months
<sup>29</sup> Hong-Van, Guozhen, Bonner, Spikes, P., Egan, Goodman, & ...	B	328	P; D; A; I; GI; STI; RV	18-29 = 22.3% 30-34 = 7.6%	US	2008-2009	UAI during last sex encounter with a male



Study	Sub-population <sup>a</sup>	N	Correlate Type <sup>b</sup>	Age	Location	Data Collection Year	Operational Definition of UAI
Koblin (2011)				35-39 = 12.8% 40-44 = 26.8% ≥ 45 = 30.5%			
<sup>30</sup> Horvath, Smolenski, Iantaffi, Grey, & Rosser (2012)	B	14	DH	<i>M</i> = 32	US	2011	UAI in past month with casual partner; UAI in past month with primary partner
<sup>31</sup> Huebner & Gerend (2001)	D	93	TO	Modal age = 30-34	US	1998	R-UAI in past 6 months; I-UAI in past 6 months
<sup>32</sup> Irwin, Morgenstern, Parsons, Wainberg, & Labouvie (2006)	N	42	A	<i>M</i> = 35	US	unspecified	UAI in past 90 days with casual partner
<sup>33</sup> Jiang, Ningxiao, Jinping, Qiang, Xiangdong, Huazhong, & ... Changgeng (2006)	N	144	P; D; AF; A	18-29 = 49.3% 30-39 = 27.8% 40-70 = 22.9%	non-US	2003	UAI in past 3 months
<sup>34</sup> Kelly, Carpiano, Easterbrook, & Parsons (2012)	N	250	D	18-30 = 31% 31-40 = 36% ≥ 40 = 33%	US	2005	I-UAI in past 3 months; R-UAI in past 3 months
<sup>35</sup> Kelly & Kalichman (1998)	N	168	Kn; A; AC; IC; PR; I; SE; In	<i>M</i> = 36 <i>SD</i> = 11.2	US	< 2002	Frequency of R-UAI in the past 3 months; frequency of I-UAI in the past 3 months
<sup>36</sup> Koblin, Chesney, Husnik, Bozeman, Celum, Buchbinder, & ... Coates (2003)	N	4295	A; I	16-19 = 2.2% 20-25 = 16.8% 26-30 = 21.3% 31-35 = 21.2% 36-40 = 17.6% > 40 = 21.0%	US	1999-2001	I-UAI with seropositive partner in past 6 months; I-UAI with seronegative or serounknown in past 6 months; R-UAI with seropositive partner in past 6 months; R-UAI with seronegative or serounknown in past 6 months

Study	Sub-population <sup>a</sup>	N	Correlate Type <sup>b</sup>	Age	Location	Data Collection Year	Operational Definition of UAI
<sup>37</sup> Léobon, Velter, Engler, Drouin, & Otis (2011)	B	13,901	P; A; In; I; S; MH; Ty; PC; TS; RV; STI	18-25 = 17.4% > 25 = 82.6%	non-US	2008-2009	Sometimes to always UAI with casual partners in the past 12 months
<sup>38</sup> Mackesy-Amiti, Fendrich, & Johnson (2010)	N	187	A; I; Rx	18-29 = 22% 30-39 = 35% 40-49 = 28% 50-55 = 15%	US	2002-2003	I-UAI with multiple partners, casual partner, or a seropositive/serounkn own partner in past 6 months; I-UAI with multiple partners in past 6 months; R-UAI with multiple partners in past 6 month; R-UAI with multiple partners, casual partner, or a seropositive/serounkn own partner in past 6 months
<sup>39</sup> Mansergh, McKirnan, Flores, Hudson, Koblin, Purcell, & Colfax (2010)	B	1540	TO; SE; IC;	18-29 = 27% 30-39 = 34% ≥40 = 39%	US	2004-2006	Last encounter of serodiscordant I-UAI; last encounter of serodiscordant of R-UAI
<sup>40</sup> Mayne, Acree, Chesney, & Folkman (1998)	B	347	B	$M = 39$ $SD = 7$ range = 24–57	US	< 2002	UAI in the past 2 months
<sup>41</sup> Mimiaga, Noonan, Donnell, Safren, Koenen, Gortmaker, & ...Mayer (2009)	N	4244	SA	$M < 35$	US	unspecified	UAI in past 6 months; UAI with seropositive or serounknown partner in past 6 months
<sup>42</sup> Miner, Peterson, Welles, Jacoby, & Rosser (2009)	D	675	C; IC; PN; SE; SC; SS	$M = 42$ range = 18-69	US	2005-2006	Serodiscordant UAI in the past 3 months

Study	Sub-population <sup>a</sup>	N	Correlate Type <sup>b</sup>	Age	Location	Data Collection Year	Operational Definition of UAI
<sup>43</sup> Mitchell, Harvey, Champeau, & Seal (2012)	N	284	RV; TH	$M = 34.1$	US	2009	UAI with secondary partner in past 3 months
<sup>44</sup> Morin, Steward, Charlebois, Remien, Pinkerton, Johnson, & ... Chesney, (2005)	D	1534	SS; MH	unspecified	US	unspecified	UAI in past 3 months with casual partner; UAI in past 3 months with steady partner
<sup>45</sup> Mustanski (2008)	N	155	D; A	$M = 28.7$ $SD = 10.3$	unspecified	unspecified	UAI in past 30 days
<sup>46</sup> Mutchler, Bogart, Elliott, McKay, Suttorp, & Schuster (2008)	D	150	GI; DH; AC	$M = 40$	US	2002	UAI without disclosure of serostatus in past 5 years
<sup>47</sup> Nöstlinger, Nideröst, Platteau, Müller, Staneková, Gredig, & ... Colebunders (2011).	D	410	SE; PN; MH; PS	$M = 44$ range = 18-85	non-US	unspecified	Percentage condom use UAI with casual partners in the past 6 months; percentage condom use UAI with primary partners in past 6 months
<sup>48</sup> O'Dell, Rosser, Miner, & Jacoby (2008)	D	637	C; I; PR; SD	$M = 42.3$ $SD = 8.2$	US	unspecified	Serodiscordant UAI in past 3 months
<sup>49</sup> O'Leary, Purcell, Remien, & Gomez (2003)	D	456	SA	$M = 37$ $SD = 8$	US	< 2002	R-UAI in past 90 days; I-UAI in past 90 days
<sup>50</sup> O'Leary, Wolitski, Remien, Woods, Parsons, Moss, & Lyles (2005)	D	405	D; SE; I; He; PR	unspecified	US	unspecified	Percentage of condom use for I-UAI with seronegative/serounk nown partners
<sup>51</sup> Outlaw, Phillips, Hightow-Weidman, Fields, Hidalgo, Halpern-Felsher, & Green-Jones (2011)	D	59	AF	$M = 20.4$ $SD = 1.9$ range = 15-24	US	2006-2009	R-UAI in past 30 days; I-UAI in past 30 days
<sup>52</sup> Parsons & Bimbi (2007)	B	356	In	$M = 36.2$ $SD = 10.17$	US	2002	Any UAI in past 3 months; R-UAI in

Study	Sub-population <sup>a</sup>	N	Correlate Type <sup>b</sup>	Age	Location	Data Collection Year	Operational Definition of UAI
				range = 18-80			past 3 months; I-UAI in past 3 months
<sup>55</sup> Parsons, Halkitis, Wolitski, & Gómez, (2003)	D	312	I; P; PRe; Te; MH	<i>M</i> = 38.6 <i>SD</i> = 8.26 range = 20-67	US	1997-1998	UAI in past 3 months
<sup>54</sup> Parsons, Kutnick, Halkitis, Punzalan, & Carbonari (2005)	D	241	I	<i>M</i> = 38.55 <i>SD</i> = 6.73 range = 19-61	US	1997-2002	Number of serounknown R-UAI casual partners in past 3 months; number of serounknown I-UAI casual partners in past 3 months; number of seronegative R-UAI casual partners in past 3 months; number of seronegative I-UAI casual partners in past 3 months
<sup>55</sup> Perkins, Leserman, Murphy, & Evans (1993)	N	24	MH; IH; PR	<i>M</i> = 31 <i>SD</i> = 7	US	< 2002	Inconsistent condom use in past 6 months
<sup>56</sup> Peterson, Miner, Brennan, & Rosser (2012)	D	174	TO	<i>M</i> = 43.6 <i>SD</i> = 7.4 range = 24-69	US	2004-2006	Serodiscordant UAI in past 3 months
<sup>57</sup> Poppen, Reisen, Zea, Bianchi, & Echeverry (2004)	D	132	AN; D; MH; RV; I	<i>M</i> = 38.5 range = 18-67	US	unspecified	Number of partners for R-UAI in past 12 months; number of partners for I-UAI in past 12 months
<sup>58</sup> Poppen, Reisen, Zea, Bianchi, & Echeverry (2005)	D	219	DH; RV	<i>M</i> = 40.8 range = 23-62	US	unspecified	UAI with last partner
<sup>59</sup> Prestage, Fogarty, Rawstorne, Grierson, Zablotska, Grulich, & Kippax (2007)	D	274	I	<i>M</i> = 45.1 <i>SD</i> = 7.77 range = 22-70	non-US	2004-2005	UAI in past 6 months
<sup>60</sup> Prestage, Jin, Kippax, Zablotska,	N	1171	I; SD	<i>M</i> = 37	non-US	2001-2004	UAI in past 6 months

Study	Sub-population <sup>a</sup>	N	Correlate Type <sup>b</sup>	Age	Location	Data Collection Year	Operational Definition of UAI
Imrie, & Grulich (2009)				range = 18–75			
<sup>61</sup> Purcell, Moss, Remien, Woods, & Parsons (2005)	D	1168	I; A;	unspecified	US	2000-2001	I-UAI with seropositive partner in past 3 months; I-UAI with seronegative or serounknown in past 3 months; R-UAI with seropositive partner in past 3 months; R-UAI with seronegative or serounknown in past 3 months
<sup>62</sup> Radcliffe, Doty, Hawkins, Gaskins, Beidas, & Rudy (2010)	D	40	IH	<i>M</i> = 20.40 <i>SD</i> = 1.99 range = 16–24	US	2008-2009	I-UAI in past 30 days; R-UAI in past 30 days
<sup>63</sup> Rawstorne, Digiusto, Worth, & Zablotska (2007)	B	1952	I	<i>M</i> = 36	non-US	2002-2005	Rates of UAI with casual partners in past 6 months
<sup>64</sup> Rawstorne, Fogarty, Crawford, Prestage, Grierson, Grulich, & Kippax (2007)	D	153	D; HM; SD; TO; Ty	<i>M</i> = 44 range = 21-68	non-US	2003	Serodiscordant UAI with casual partners in past 6 months
<sup>65</sup> Ross, Rosser, & Neumaier (2008)	D	675	SE; P; DH	Median = 42	US	2005-2006	Serodiscordant UAI in past 3 months
<sup>66</sup> Rusch, Lampinen, Schilder, & Hogg (2004)	N	261	A; I	Median = 27 range = 21-40	non-US	1997-2002	any UAI in past 6 months; R-UAI in past 6 months; I-UAI in past 6 months
<sup>67</sup> Safren, Traeger, Skeer, O’Cleirigh, Meade, Covahey, & Mayer (2010)	D	354	SE	<i>M</i> = 42 <i>SD</i> = 8	US	2004-2007	UAI in past 3 months with seronegative/serounknown partner
<sup>68</sup> Schutz, Godin, Kok, Vézina-Im, Naccache, & Otis (2011)	D	237	PBC; PN; SE; I; In; AR; D	<i>M</i> = 42.5 <i>SD</i> = 8.8	non-US	2004-2007	UAI in past 6months

Study	Sub-population <sup>a</sup>	N	Correlate Type <sup>b</sup>	Age	Location	Data Collection Year	Operational Definition of UAI
				range = 18-77			
<sup>69</sup> Schwarzc, Scheer, McFarland, Katz, Valleroy, Chen, & Catania (2007)	B	1977	P; I; SD; S; TS; TO; D	Median = 42 range = 18-92	US	1996	I-UAI with seronegative or serounknown non-primary partner in past 12 months; R-UAI with seropositive/serounknown non-primary partner in past 12 months
<sup>70</sup> Semple, Patterson, & Grant (2000)	D	104	SE; PR; RV	<i>M</i> = 37.3 range = 23-60	US	1996-1999	UAI with casual partner in past 4 months; UAI with steady partner in past 4 months; mean number of UAI acts in past 4 months
<sup>71</sup> Semple, Patterson, & Grant (2003)	D	322	HM	<i>M</i> = 37.0 <i>SD</i> = 7.1 range = 22-62	US	1996-2000	UAI in past 4 months
<sup>72</sup> Simon Rosser, Oakes, Horvath, Konstan, Danilenko, & Peterson (2009)	D	119	S	unspecified	US	2005	UAI in past 3 months
<sup>73</sup> Vanable, Ostrow, McKirnan, Taywaditep, & Hope (2000)	B	554	PR	<i>M</i> = 35 <i>SD</i> = 9.6	US	1997	UAI in past 6 months
<sup>74</sup> Van de Ven, Mao, Fogarty, Rawstorne, Crawford, Prestage, & ... Kippax (2005)	D	94	HM	<i>M</i> = 37.7 <i>SD</i> = 7.67 range = 22-53	non-US	2001-2003	Serodiscordant UAI in past 6 months
<sup>75</sup> Welles, Baker, Miner, Brennan, Jacoby, & Rosser (2009)	D	169	SA	18-25 = 2.7% 26-35 = 17.6% 36-45 = 47.3% ≥46 = 32.4%	US	2005-2006	Serodiscordant/serounknown UAI in past 90 days
<sup>76</sup> Whittington, Morris, Buchbinder,	N	1257	VT	<i>M</i> ~ 36	US	2001-2002	any R-UAI in past 3

Study	Sub-population <sup>a</sup>	N	Correlate Type <sup>b</sup>	Age	Location	Data Collection Year	Operational Definition of UAI
McKirnan, Mayer, Para, & ... Celum (2006)							months; R-UAI with seropositive partner in past 3 months; R-UAI with seronegative/serounk nown partner in past 3 months; any I-UAI in past 3 months
<sup>77</sup> Yi, Sandfort, & Shidlo (2010) <sup>c</sup>	N	285	I; IH; PR; SE; S; TO	<i>M</i> = 35.6 <i>SD</i> = 8.70 range = 18-66	US	2003-2004	UAI with casual partner in past 6 months
<sup>77</sup> Yi, Shidlo, & Sandfort (2011) <sup>c</sup>	N	285	PR; SE	<i>M</i> = 35.6 <i>SD</i> = 8.70	US	2003-2004	UAI in past 6 months
<sup>78</sup> Zablotska, Prestage, Holt, Poynten, de Wit, Guy, & ... Grulich (2011)	N	3591	PeP	majority < 40	non-UAI	2001-2010	UAI with casual partner in past 6 months

<sup>a</sup> D = HIV diagnosed; N = HIV non-diagnosed; B = both diagnosed and non-diagnosed

<sup>b</sup> A = alcohol; AC = attitudes toward condoms; AD = AIDS diagnosis; AF = age of first sex; AN = acculturation; AR = anticipated regret; B = bereavement; BC = bar and club attendance; C = compulsivity; D = demographics; DH = disclosure of HIV-related information; GI = gay identity; He = hedonism; HM = HIV medical management; I = illicit drug use; IB = interpersonal barriers; IC = intention to use a condom; IH = internalized homophobia; In = intention; K = knowing people with HIV; Kn = knowledge about HIV; Ma = masculinity; MH = mental health functioning; P = number of partners; PBC = perceived behavioral control; PC = personality characteristics; PeP = use of non-occupational post-exposure prophylaxis; PN = perceived norms; PR = perceived risk; Pre = perceived responsibility; PS = partner status; RV = relationship variables; Rx = other prescription drugs; S = setting; SA = childhood sexual abuse; SC = sexual comfort; SD = sexual dysfunction medication; SE = self-efficacy; SS = social support; STI = STI diagnosis; Tb = tobacco; Te = temptation; TH = time since HIV diagnosis; TO = treatment optimism; TS = traded sex; Ty = type of sex act; VT = participation in HIV vaccine trial

<sup>c</sup> Yi, Sandfort, and Shidlo (2010) and Yi, Shidlo, and Sandfort (2011) were treated as a single study in analyses, as their samples are identical.

## **APPENDIX I: CODING SHEET FOR HIV RISK VARIABLES**



Citation (APA format):

Sample Characteristics

*n*: \_\_\_\_\_

Biological sex: \_\_\_\_\_

Racial/ethnic breakdown of sample: \_\_\_\_\_

Identified sexual orientation breakdown: \_\_\_\_\_

Socioeconomic status or income level information: \_\_\_\_\_

Age: \_\_\_\_\_

Relationship status: \_\_\_\_\_

Variable Information

Variable(s) assessed: \_\_\_\_\_

Setting/location in which sampling occurred: \_\_\_\_\_

Outcome variable(s) assessed: \_\_\_\_\_

Year(s) data collected: \_\_\_\_\_

Research design and methodology

Research design: \_\_\_\_\_

Sampling type: \_\_\_\_\_

Type of assignment: \_\_\_\_\_

Comparative group (if any): \_\_\_\_\_

Test instruments and associated statistics:

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Statistical outcomes/effect sizes (if available):

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Additional comments

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**APPENDIX J: SUPPLEMENTAL REFERENCES INCLUDED IN META-ANALYSES**

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