# PSYCHOSOCIAL ASSOCATIONS OF BIOBEHAVIORAL HIV PREVENTION AMONG BLACK MEN WHO HAVE SEX WITH MEN IN THE UNITED STATES

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## ABSTRACT

Black men who have sex with men (BMSM) experience the highest HIV incidence among at-risk groups; therefore, understanding the unique circumstances of BMSM is essential to addressing this significant public health issue. The theory of syndemic production, or the effect of co-occurring epidemics, was used to explore the result of psychosocial issues (substance use, intimate partner violence, sexual risk and depression) on HIV prevention and care outcomes. This dissertation analyzed data from the Promoting Our Worth, Equality and Resilience (POWER) study to explore the impact of individual-level syndemics on past six-month screening behavior, PrEP use and HIV care continuum outcomes among BMSM. In the first analysis, BMSM under 30 were more likely to have been screened than BMSM aged 40 and older (AOR = 2.18, 95% CI: 1.74, 2.72). Further, despite the presence of a syndemic, men with two psychosocial issues were significantly more likely to report being screened for HIV compared to men who reported no psychosocial issues (AOR = 1.37, 95% CI: 1.04, 1.80). The second analysis explored differences among BMSM who reported PrEP-eligible HIV risk and BMSM who reported using PrEP. The analysis found that those with a college education (AOR = 0.39, 95% CI: 0.28 – 0.55) and graduate education (AOR = 0.50, 95% CI: 0.32, 0.79) were significantly less likely than men with a high school or less education to report PrEP use. Additionally, compared to men who reported no psychosocial issues, BMSM were significantly

more likely to report PrEP use when experiencing three (AOR = 5.65, 95% CI: 3.17, 10.08) or four psychosocial issues (AOR = 18.34, 95% CI: 5.01, 67.20). The third analysis focused on HIV-positive BMSM found that BMSM without insurance were less likely to report being in HIV care (AOR = 0.13, 95% CI: 0.05, 0.36) or using ART (AOR = 0.33, 95% CI: 0.20, 0.54). There were no significant associations between syndemic variables and HIV care outcomes. The results of these analyses suggest that individual factors cannot entirely explain disparities in HIV incidence and demonstrate the need to model the social and structural ecology of BMSM contributing to excess disease burden.

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# PREFACE

I would be remiss without pointing out the various inspirations and motivations that have encouraged this dissertation.

I drew on this history and work ethic my family when completing this work. Despite the passing of both of my grandmothers while in the program, I was determined to finish this journey. My paternal grandmother used her eighth-grade education to teach me to read and write prior to school entry. It is not lost on me that the grandson of a custodian at the University of Florida now walks the halls of the University of Pittsburgh with terminal degree.

I could not have made it through this program without the support of those closest to me. My partner, Rene Alvarez, who is also a doctoral student has been with me on late nights and in the trenches of the daily grind – laptops opened and clicking away into the early morning. My parents, Leroy and Emma Chandler, have been a constant reminder of why I came into this work. As a pastor in a rural area, my father has led local HIV campaigns and redefined what it means to be a person of faith and a crusader for social justice. My younger sibling's desire to gain his second degree was certainly a driver helping to push me forward in times when earning my degree seemed too complicated for reason.

I came to the University of Pittsburgh because it was a national leader in LGBT health research led by an impeccable team who were productive and welcoming. The fact that the

Center for LGBT Health Research was poised to study HIV among Black men who have sex with men made the choice of studying in Pittsburgh crystal clear. Within the center, I was given the ability to witness and participate in research generation that spurred my own work. Center faculty and members of our Wednesday morning research lab reviewed constant drafts of tables and summaries and helped me sharpen my assessment tools.

I want to thank my committee that was unwavering in their desire to push me to think not only about the mechanism of asking questions, but to explore research that can impact future studies.

Lastly, I want to thank my colleagues who worked on POWER and the POWER participants. I have worked on several studies, but few have been as fun, rewarding and meaningful as POWER. I have been beyond fortunate to contribute to literature about other queer people of color.

# 1.0 INTRODUCTION

More than three decades into addressing the Human Immunodeficiency Virus (HIV) epidemic, disparities in HIV screening, prevention uptake and treatment persist among Americans, particularly among men who have sex with men (MSM). These disparities are most noted among Black men who have sex with men (BMSM) and White MSM. Concerns about HIV incidence and prevalence have become synonymous with the health of BMSM, yet there is exists a dearth in the most influential factors driving these disparities. Current models and estimates have not sufficiently been able to identify mechanisms of disparity creation and promotion, nor do they fully explain the complex constellation of ecological factors which result in these ongoing disparities. Despite public health campaigns to address the epidemic, there continue to be calls for more specific and holistic approaches to addressing HIV among BMSM.

Although research with MSM has been pivotal to advancements in HIV prevention and care to date, not all populations have participated or benefited equally. For much of the time, studies focused on sexual minority men (i.e. gay, bisexual) were overwhelmingly White. This concentration indicated that the challenges, risk correlates and resilience mechanisms of urban White MSM were better understood and that programs were tailored primarily for White MSM. The relatively small subpopulations of people of color, especially BMSM, in early research and intervention development were not large enough to allow for meaningful statistical analysis or to discover the unique ways in which BMSM differed from White MSM. Further, these small

samples did not allow for the discovery of any nuanced subpopulations within BMSM, a critical shortcoming of early work in the field.

As research and technology continue to advance, public health has become more than the reduction of death and disease; there is an increased emphasis on a commitment to social justice—a guiding principle that asks practitioners to not only share costs and benefits of public health advances equally, but to do so in consideration of the most marginalized groups within the population. That imperative is essential in commencing the necessary research to move the field of public health forward for the achievement of equity.

This dissertation explores the experiences of BMSM and the impact of those experiences on HIV screening, HIV biomedical prevention and HIV treatment using a national sample from the Promoting Our Worth, Equality and Resilience (POWER) study conducted from 2014 through 2017. Beginning by discussing the social justice imperative, extant epidemiological trends and theoretical approaches, the three analyses presented contribute to an improved understanding of the HIV epidemic among BMSM and provide insight on the critical next steps of modeling the ecology that contributes to the HIV challenges faced by BMSM.

## 1.1 USING SOCIAL JUSTICE AS PUBLIC HEALTH

A core component of public health is justice: the ability to share and disburse common benefits and burdens among a population equally (Beauchamp, 1976). The use of justice has been critiqued by many outside of public health for being boundless and lacking focus; however, social justice offers an important direction to the types of impact sought by public health practitioners (Philpott, 2013). Social justice brings attention to the need to address the ecological

factors impacting the health of disadvantaged or marginalized groups. Often the health outcomes and behaviors of the disadvantaged minority are markedly different than a comparative majority and the social ecology can actively work to prevent or limit healthy decision-making.

In the United States, there exist two primary forms of health-related justice: market justice and social justice. The familiar concept of market justice focuses on the rights and responsibilities of each individual, rather than the appeal to the collective. Much of American life is governed by market-justice: the idea that status, income and subjective goals such as happiness are based on individual efforts and resources. This model of justice limits collective responsibilities and can deflect collective actions regarding behaviors considered voluntary; greater importance is placed on freedom of choice in resources and actions than equality and equity (Beauchamp, 1976; Drevdahl, 2002). Early beliefs that HIV infection was a consequence of immoral behavior, the result of voluntarily engaging in same sex behavior for men who had sex with men or intravenous substance users, resulted in calls for abstinence and increased policing of substance abuse activities. Such activities are examples of the application of market justice.

Social justice confronts market justice by acting as a critique of individualism and "blaming the victim" (Beauchamp, 1976). There are four principles in applying social justice in public health: the control of hazards; prevention of death and disability; use of collective action to address public health problems; and ability to equitably share benefits and burdens among the population taking into consideration the most vulnerable (Beauchamp, 1976). Using these principles to examine HIV among Black men who have sex with men (BMSM) contextualizes the disparities documented within the literature and provides cues to needed research and action.

### 1.1.1 Controlling Hazards

Key to understanding the lack of effectiveness in public health efforts to stem the more than three-decades long campaign against HIV is comprehension of the unique hazards of HIV transmission among BMSM. These hazards include behavioral considerations as well as structural and environmental factors (Beauchamp, 1976). Epidemiological trends highlight disturbing disparities in the seroconversion rates for BMSM compared to other MSM. These trends provide background to the ongoing needs of a marginalized population and provide evidence to use two theoretical frameworks to examine health outcomes: intersectionality theory and syndemics theory in addition to the social ecological model for BMSM and HIV (Crenshaw, 1989; McLeroy, Bibeau, Steckler, & Glanz, 1988; Singer, 1994). These frameworks demonstrate the need for parity between studies of epidemiology, social ecology and behavioral interventions for the amelioration of HIV transmission.

#### 1.1.1.1 Epidemiology

Since 2005, MSM in the 48 contiguous United States have accounted for at least half of all new cases of HIV at a slowly increasing percentage (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 2013). Current Centers for Disease Control and Prevention (CDC) estimates demonstrate a disparity between MSM and heterosexuals within the United States. Incidence trends over the last decade show the odds of lifetime HIV seroconversion are 1 in 99 for the general population, but 1 in 6 for MSM (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 2014a). These estimates, when examined through race and ethnicity, show a stark contrast: the odds of White

MSM seroconversion are 1 in 11; 1 in 4 for Hispanic/Latino MSM; and 1 in 2 for BMSM (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 2014a).

### *Origins of Specific BMSM Study*

Given the stark differences in lifetime HIV seroconversion among MSM, it was imperative that researchers began to expand the understanding of MSM as more than a monolith, specifically the lives of BMSM. For example, a 2005 National HIV Behavioral Surveillance (NHBS) study of 450 MSM noted lower testing rates among BMSM as well as a high rate of unrecognized HIV infections compared to other MSM in the study (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 2005). The same study reported that 48% of the seropositive men were previously unaware of their status; BMSM represented 64% of those new HIV infections (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 2005). Shortly after this study, a body of research began to emerge to elucidate the underlying reasons for the large differences in incidence rates among Black and White MSM.

### *Understanding the Significance of HIV Incidence*

In order to understand the significance of HIV incidence among MSM, statistical simulations have been conducted among groups of MSM. A 2009 study of urban MSM used a mean 2.39% incidence rate for all MSM and modeled a simulated cohort of 4000 MSM for HIV positivity from ages 18 to 40. The study found that if the incidence remained at that level consistently, nearly a quarter of the MSM in the cohort would be positive by age 30 and that that percentage rose to 40% as the cohort reached age 40 (Stall et al., 2009). Due to the increased need to study BMSM and understand the distinctive trends that this group encounters, a 2014

study simulated the progression of seroconversion among a cohort of 4000 BMSM from ages 18 to 40. Using an annual incidence rate of 4.16% as the average of previous incidence estimates among BMSM in urban centers, the study found that by age 30, nearly 40% of the sample would seroconvert and just over 60% would have seroconverted by age 40 (Matthews et al., 2016). Both studies demonstrated the need to better understand the lives of MSM, particularly BMSM if rising HIV rates over the life course are to be addressed.

### *Sexually Transmitted Infections other than HIV*

A significant contributor to co-infections, and often a bellwether of HIV risk are sexually transmitted infection (STI) diagnoses among MSM. These co-infections were the first form of biological syndemic, either by increasing susceptibility or advancing viremia among BMSM who had acquired HIV (Singer, Bulled, Ostrach, & Mendenhall, 2017). STI can increase the likelihood for HIV infections; therefore, it has been important to take into account the differences between MSM and their heterosexual counterparts (Fleming & Wasserheit, 1999). The CDC estimates that although MSM only account for about two percent of the general population, they are 60 times more likely than heterosexual men to be diagnosed with syphilis or HIV (Guadamuz et al., 2013; Wolitski & Fenton, 2011). Additionally, gonorrhea and chlamydia are more likely to be diagnosed among MSM compared to their heterosexual counterparts, representing increased risk for HIV infection (Fleming & Wasserheit, 1999; Patton et al., 2014; Solomon et al., 2014). Black MSM have experienced more STI infections and HIV seroconversions per year than White or Hispanic MSM for more than a decade displaying a disparity in both STI vulnerability and HIV infections (Hall et al., 2015; Rosenberg, Millett, Sullivan, del Rio, & Curran, 2014; U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 2008).

#### 1.1.1.2 HIV Risk Factors

The increased incidence of HIV and STI among BMSM encouraged early explanations for the differences in rates between BMSM and other MSM which relied on individual behavior. Beginning in 2006, Millet and colleagues began to compile the various studies and conclusions about BMSM and analyzed this literature with twelve hypotheses related to higher infection rates for BMSM. The analysis found that BMSM had higher background STI rates facilitating HIV infection and were less likely to be tested for HIV than other MSM (Millett, Peterson, Wolitski, & Stall, 2006). The critical literature review went on to discuss that extant literature at the time did not support hypotheses that: BMSM were engaged in more sexual risk than other MSM, that BMSM used illicit substances at a higher frequency or that BMSM were less likely to identify as something other than heterosexual (Millett et al., 2006). An additional seven hypotheses could not be confirmed or refuted by evidence at the time, including the role of social and sexual networks of BMSM, any impact from a history of incarceration and the possibility of genetic differences increasing viremia among BMSM (Millett et al., 2006).

The 2007 meta-analysis of 53 studies that followed the 2006 critical literature review found similar results: heightened rates of BMSM positivity were not being driven solely by individual factors of HIV infection as BMSM reported the same or fewer sexual partners, equal or less substance use correlated with HIV infection and the same or less condomless anal intercourse (Millett, Flores, Peterson, & Bakeman, 2007). The analysis suggested that BMSM were less likely than White MSM to be retained in antiretroviral therapy, BMSM experienced higher background STI than other MSM and that a more concentrated epidemic with condomless sex early in the HIV epidemic were contributing factors to HIV transmission rates among BMSM (Millett et al., 2007).

Oster and colleagues used 2008 NHBS data to continue to test hypotheses about differences in BMSM and other MSM related to HIV acquisition and transmission, specifically focused on HIV status of last sexual partner, history of incarceration, circumcision, duration of infectiousness and the impact of sexual network (Oster et al., 2011). Rates of MSM unaware of their positive serostatus differed greatly from 25% among White MSM to nearly 60% among BMSM. Additionally, since BMSM were more likely to date other BMSM and were less likely to know their own or their partner's status, sexual network was considered to contribute to HIV risk (Oster et al., 2011). Taken together, these factors make a case for addressing prevention and treatment at multiple levels of the social ecology.

Aside from these epidemiological factors, another contributor to HIV transmission risk is depression among BMSM (Maulsby et al., 2014; Reisner et al., 2009). Depression symptomology has been cited among studies of psychosocial components of HIV risk among MSM and has been shown to have an impact on linkage to care and retention for men living with HIV (Bruce, Harper, & Adolescent Medicine Trials Network for HIV/AIDS Interventions, 2011; A. Laurel Herrick, 2011; Wilson et al., 2014). The ability address the epidemiological and well as psychosocial lives of BMSM is essential in being able to design appropriate HIV prevention and care strategies.

### 1.1.2 Prevention of Death and Disease

Public health is a purposefully multidisciplinary field of practice that is focused, in the strictest sense, on eliminating morbidity and mortality (Kass, 2001). While epidemiology is an essential facet of public health, there are additional considerations at play. In fact, the social ecological

model (SEM) of health is one of the ways many public health practitioners explain the multiple influences, both proximal and distal, to health behavior and outcomes.

#### 1.1.2.1 Social Ecological Approaches to HIV Prevention

Over the more than 30 years that HIV has been tracked within the US, several methods of prevention have emerged. Early in the epidemic, there were few tools available other than condoms and behavioral controls (i.e. limiting the number of an individual's sexual partners, limiting sexual behavior while under the influence of drugs); however, later years attempted to address the needs of those living with HIV and at risk for HIV with a collection of individual, interpersonal, community and policy interventions. The CDC catalogued these interventions into a compendium called the Diffusion of Evidence Based Interventions (DEBI) program and provided training and technical assistance for the growing public health response to HIV beginning in 1999 (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 1999, 2017). A systematic review of the first five years of the DEBI program identified that early interventions were primarily focused on heterosexual populations; the few interventions created for MSM were studied with overwhelmingly White participants (Lyles et al., 2007). After critiques and calls to action for specific prevention tools for BMSM and other MSM of color, there are three interventions specific to HIV risks among BMSM (Peterson & Jones, 2009; Wilton et al., 2009).

##### *Individual*

Several of the early interventions aimed at reducing HIV among MSM were centered around the behavior of the individual (D. A. Cohen & Scribner, 2000). In fact, primary responses were to provide use the social cognitive theory and theory of reasoned action to educate and

bring awareness to MSM about the dangers of HIV. Several interventions focused on the health education and promotion of protective behaviors for personal responsibility; the primary being risk reduction counseling and skill building models (D. A. Cohen & Scribner, 2000). These interventions did have some limited effects, but were critiqued because they could not be sustained over time as many studies had short or varying follow-up periods (Crepaz et al., 2007; DiClemente & Wingood, 2000; Herbst et al., 2007; Herbst et al., 2005; Johnson et al., 2008). Early studies of efficacy identified that BMSM required tailored interventions specific to their life experiences (Herbst et al., 2005). Even with tailoring, it was clear through the evolution of literature that individual behaviors and interventions were not enough on their own to make significant and sustained impacts in reducing HIV incidence among MSM, including BMSM (Sullivan et al., 2012b). As an essential level of behavioral prevention, development of new individual approaches to HIV prevention are still forthcoming, using technology such as mobile phone applications as the next frontier (Noar, Black, & Pierce, 2009).

### *Interpersonal*

Increasing the individual awareness of HIV among MSM provided a basis for the normalization of conversations about HIV among individuals who have both primary and casual sexual partners. Additionally, public health campaigns encouraged MSM to test with partners and review their status in clinics and community organizations which offered testing. Many community based organizations (CBO) offered couples risk reduction counseling and testing. Some interventions were aimed specifically for individuals in serodiscordant relationships, including sexual health and disclosure skills (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 1999, 2017).

### *Community*

Community-level responses to HIV varied widely, but began with large information campaigns. From these campaigns, community actions such as the organization of HIV testing drives and condom distribution to bars, bath houses and other LGBT-focused spaces became commonplace (Jones et al., 2008; Needle et al., 2003). More recent interventions have included group-based activities, such as *Many Men, Many Voices, Popular Opinion Leader* and *D-Up: Defend Yourself!* among others (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 1999, 2017). These groups were focused on providing education and skills to BMSM in order to improve the shared community norms (Crepaz et al., 2007; Johnson et al., 2008). In this way, using peer education was thought to create an organic diffusion of innovations that would reduce HIV incidence (Jones et al., 2008). Evaluations of these interventions did find decreases in condomless anal intercourse and in some cases found that the interventions improved the number of individuals who tested for HIV in the six months post intervention (Jones et al., 2008; Wilton et al., 2009). These group-level interventions not only helped create skills and encouraged norms of disclosure and testing, but they shaped discussions about larger societal issues such as racism, internalized homophobia and discrimination within their materials (Jones et al., 2008; Peterson & Jones, 2009).

### *Policy and Structural Interventions*

Policies governing HIV have consistently been controversial (Burris, Beletsky, Burleson, & Case, 2007). Due to the nature of HIV as a communicable disease, several laws throughout the US regulate this condition and disclosure of HIV status (Galletly & Pinkerton, 2006). In terms of criminalization, there is a consistent debate about the need to contain HIV and protect the public from a minority of individuals who may knowingly transmit HIV compared to the

possible stigma and fear that such laws may inflict (Burris et al., 2007; Cox, 2016). In fact, some research suggests that due to many of the laws across the US and their patchwork nature, HIV risk may be increased (Burris et al., 2007). One empirical trial study of HIV law comparisons with MSM in New York and Illinois found that criminalization laws do not directly influence sexual risk behavior, but developing such laws may decrease cooperation with the healthcare system or fuel HIV stigma (Burris et al., 2007).

Aside of criminalization policies, HIV prevention efforts have highlighted the need to address societal and structural factors driving the HIV epidemic among BMSM: racism, homophobia, access to healthcare and income inequalities (Peterson & Jones, 2009). One qualitative research study has indicated that HIV risk among younger BMSM is impacted by HIV-specific stigma, homophobia and racism creating a collective silence among the population to address the issue (Arnold, Rebchook, & Kegeles, 2014). Statistical modeling has also indicated financial hardships and social discrimination were associated with sexual risk among Black and Latino MSM (Ayala, Bingham, Kim, Wheeler, & Millett, 2012). Addressing these structural barriers requires time, resources and multiple layers of interventions still in progress (Peterson & Jones, 2009). While structural interventions to HIV prevention are perhaps the most resource intensive, addressing these societal factors is clearest conduit to using social justice to make sustained impacts at all the levels of social ecology.

#### 1.1.2.2 Biomedical Prevention

Beginning in 2007, researchers began studying the possibility of chemoprophylaxis for HIV using a combination of emtricitabine (FTC) and tenofovir disoproxil fumarate (TDF) combination therapy in a single tablet (FTC–TDF) (Grant et al., 2010). Researchers initially began thinking about pre-exposure prophylaxis to HIV based on illicit markets of antiretroviral

medications (ARVs) found in at least seven states in the US and years of reports throughout the US and Europe of “disco dosing”, a phenomenon where partygoers take ARVs prior to joining sex parties (Kurtz, Buttram, & Surratt, 2014; Philpott, 2013). After several studies demonstrated varying levels of effectiveness ranging between 44% and 77% reduction of incidence among those in the iPrEx trial, the US Food and Drug Administration (FDA) approved Truvada® for use as pre-exposure prophylaxis (PrEP) in 2012 (Grant et al., 2010; U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 2012). The STRAND trial, a study of TDF-only dosing, found concentrations of TDF in blood corresponding with HIV risk reduction. With 2 doses per week, the study reported a concentration corresponding to a 76% reduction; four doses per week corresponding to a 96% reduction and a 99% reduction with seven doses in a week (Anderson et al., 2012).

Despite the success of PrEP in several trials, BMSM and young MSM were underrepresented in many of the original trials (Pace, Siberry, Hazra, & Kapogiannis, 2012). Even after the approval of PrEP by the FDA, quantitative and qualitative research with BMSM showed less awareness, acceptance and uptake of PrEP than other MSM (Eaton, Driffin, Bauermeister, Smith, & Conway-Washington, 2015; Krakower et al., 2012; Smith, Toledo, Smith, Adams, & Rothenberg, 2012). Several studies pointed to three factors for lowered acceptance: BMSM have concerns about side effects given the historical mistrust of the scientific establishment; many BMSM, especially young BMSM are used to receiving HIV information and testing from community based organizations; and, BMSM are more likely to lack insurance, causing a shortage in access to PrEP (Pérez-Figueroa, Kapadia, Barton, Eddy, & Halkitis, 2015; Smith et al., 2012). At least two studies also discussed the concerns of behavioral disinhibition described by the participants as well as concerns about the ability to maintain trust and fidelity in

monogamous relationships while on PrEP (Pérez-Figueroa et al., 2015). When BMSM were specifically targeted for trails, the favorability of PrEP use increased; studies from Los Angeles and the HIV Prevention Trials Network (HPTN) demonstrate that BMSM are willing to use PrEP given that there is a community voice included in the marketing and development of PrEP dissemination campaigns (Brooks, Landovitz, Regan, Lee, & Allen Jr, 2015; Lucas et al., 2014).

The second biological HIV prevention transmission strategy is named Treatment as Prevention (TasP). This strategy ended years of debate among HIV specialists and researchers about the appropriate time to use antiretroviral therapy (ART) for individuals living with HIV (J. Cohen, 2011). Previously, guidance for using ART was based on the CD4 counts of individuals; however, the HPTN 052 used serodiscordant couples to study immediate and various delayed initiations of ART (Grinsztejn et al., 2014; Hammer et al., 2008). The study found that ART was well tolerated by most study participants and that being on ART could reduce transmission of HIV by up to 96% (E. M. Gardner, McLees, Steiner, Del Rio, & Burman, 2011). This shift in the treatment of HIV not only signaled an improved way to reduce HIV transmission events, but also helped to spur the term "test and treat" encouraging public health professionals to initiate ART with clients as soon after diagnosis as possible (E. M. Gardner et al., 2011; Walensky et al., 2010). Statistical models in both British Columbia and the US found that with increases in early ART initiation, new infections could conservatively be reduced by 18% to 73% in the next two decades; however, behavioral disinhibition, such as a lack of condom use, and lack of adherence to medication regimens would hamper those gains (Sorensen et al., 2012).

These biological prevention efforts, while focused on different populations, have similar concerns in that access to the biomedical agents are limited, adherence to the regimens is critical, and that behavioral disinhibition in the early stages of initiation appears to be a threat to the

effectiveness of either method (Brooks et al., 2015; Pérez-Figueroa et al., 2015; Sorensen et al., 2012). Still, researchers are keen to maintain that multiple methods of prevention are needed to address the HIV epidemic among MSM, particularly among BMSM. A recent bioethics study using the public health stewardship framework identified that public health professionals will need to not only scale up HIV screening and treatment with TasP, but that PrEP will be an important and cost-efficient way to address the epidemic (Haire & Kaldor, 2013).

#### 1.1.2.3 Theoretical Foundations

In order to address the outstanding reasons for the disparities in HIV incidence, it is important to review several public health theories specific to the study of BMSM. While the SEM is helpful in explaining the levels at which interventions may be targeted, it is important to understand how factors may combine to create health outcomes.

##### *Intersectionality*

The historic introduction of intersectionality by Kimberlé Crenshaw (1989) discussed the complexity of compounded marginalization brought on my multiple identities within a single individual (Crenshaw, 1989). Crenshaw critiqued both the antiracist and feminist movements at the time for forcing Black women to choose between groups seeking to reduce oppression for Black people and seeking to reduce oppression for women. As such, some scenarios may ask participants of a particular group to choose to associate with one identity more than the another, or perhaps to view their identities hierarchically; however, Crenshaw made the argument that the experience of Black women was uniquely complicated by being both Black and female and these multiple identities created unique circumstances for this population (Crenshaw, 1989).

Since this original publication, intersectionality has been used to explore the complexities within other groups and has been used in public health literature, including for BMSM (Bauer, 2014; Bowleg, 2013; McGibbon & McPherson, 2011; Viruell-Fuentes, Miranda, & Abdulrahim, 2012). Understanding how these individual identities interact and serve to provide both privilege and oppression has an impact on the experiences of social and societal inequities (Bowleg, 2012; Young & Meyer, 2005). Intersectionality has been used in public health to advance the commitment to justice, particularly social justice, in understanding how to intervene at the multiple levels of oppression and ecology surrounding marginalized populations (Bowleg, 2012). Three foci of intersectionality are critically important to public health: (a) social identities are intersecting and not independent, and therefore they should be studied as such; (b) the most critical information for analysis is derived from the experiences of historically marginalized groups rather than framing analysis from the perspective of the privileged; and (c) individual factors interact with structural factors to create health inequities (Bowleg, 2012).

### *Using Intersectionality in Healthcare Research*

Using intersectionality theory within quantitative health research has several challenges. These challenges include: (a) a lack of methods to estimate any order or hierarchy assigned to identities by each individual for analysis; (b) much of the intersectionality literature is quantitative, offering little in the way of guidelines and benchmarks for quantitative analysis; (c) there remains a difficulty in statistically modeling interaction variables to explain the relationship between identities; and (d) the data collected related to intersectionality may be too complex to succinctly comply with methodological assumptions typically seen in statistical methods (Bowleg, 2012).

Theorists and researchers currently believe that an analysis of variance (ANOVA), latent class analysis, hierarchical regression and dichotomous logistic regression are among the best ways to quantitatively explore intersectionality (Bauer, 2014). Depending on the focus of the inquiry into intersectionality, it may or may not be appropriate to control for demographic variables when demographics may indicate a specific identity (Bauer, 2014). When the focus of quantitative query is based on the identities themselves, those identities must be included in the analysis; however, if the focus of the analysis is marginalization, controlling for these demographic identities is appropriate (Bauer, 2014). There are two primary methods of discussing effects within analysis of intersectional data: interaction terms and effect sizes. For cross-sectional data, researchers have agreed that the best method is the addition of interaction terms to the regression model (Bauer, 2014). When attempting to compare interactions in variables among groups, effect sizes are more appropriate (Bauer, 2014). Some authors suggest that the relative excess risk due to interaction (RERI) may also be appropriate for analysis involving impacts that are not simply additive such as those in intersectionality (Andersson, Alfredsson, Källberg, Zdravkovic, & Ahlbom, 2005; Bauer, 2014).

### *Syndemic Production*

Merrill Singer, the well-known medical anthropologist, introduced the concept of syndemics and syndemic production in his seminal paper about the co-occurring epidemics among the urban poor (Singer, 1994). In his analysis, Singer discussed that the epidemic and endemic challenges to urban poor were not only happening concurrently, but they were mutually enhancing one another, with a proposed effect on the HIV crisis greater than their additive effects alone (Singer, 1994). The term syndemic is created from the prefix, syn meaning “to work together”, the Greek word “demos” meaning “of the people” and the ending from epidemic

meaning to spread disease in a given distribution (Singer, 2000, p. 13). One of Singer's most widely cited examples is the SAVA (substance abuse, violence and AIDS) syndemic he described in urban dwellers within the United States (Singer, 2000). Singer notes that the epidemics making up SAVA are intertwined in mutually reinforcing ways that were yet to be discovered, but key to understanding how to address the syndemic (Singer, 2000).

In 2003, Stall and colleagues published findings from a cross-sectional, household probability sample of MSM that sought to explore the possibility of a syndemic increasing HIV risk (Stall et al., 2003). Using multivariable logistic regression models with a psychosocial issue count (or syndemic "count" variable), the study found the presence of a syndemic among MSM that displayed increasing sexual risk and HIV prevalence as levels of reported psychosocial problems increased (Stall et al., 2003). In addition to documenting a syndemic among urban MSM, the study also made a case the psychosocial issues creating the syndemic were not just important on their own, but perhaps were offering the opportunity to address the HIV epidemic by studying the additive interplay of these conditions (Stall et al., 2003).

Following this paper, syndemics has been used to study HIV within specific locales, allowing for the discovery of local syndemics as well as the specialization of syndemics to particular racial groups, or age groups. One of the chapters in *Unequal Opportunity: Health Disparities Affecting Gay and Bisexual Men in the United States* specifically outlines the use of syndemics to explain the deleterious health effects of the HIV syndemic in urban MSM, but offers that the effects may be magnified in racially marginalized groups, or in MSM who are of lower socioeconomic status (Stall, Friedman, & Catania, 2008). Given this basis, it is not surprising that studies of syndemics have been completed on MSM in Miami, New York and Massachusetts as well as specific studies focused on youth, BMSM and Latino MSM (Bruce et

al., 2011; Dyer et al., 2012; Kurtz, 2008; Lyons, Johnson, & Garofalo, 2013; Wilson et al., 2014).

One of the consequences of studying syndemics among MSM has been the discovery of MSM who persevere despite exposure to discrimination and psychosocial challenges. This led to the beginning of a theory of resilience for MSM and the suggestion that syndemics can not only be used to discuss the negative effects of psychosocial issues on health, but can be used to elucidate resilient characteristics in the production of behavioral interventions (Amy L Herrick et al., 2011).

Despite the popularity of syndemics as a method of explaining interlocking epidemics and social factors, demonstrating the empirical nature of syndemics has been critiqued in some contexts. The use of the syndemic count variable may not fully account for the relationship between variables, suggesting the impact of the count variable to seem purely additive (Tsai & Burns, 2015). It has been suggested that this lack of complexity may oversimplify the interplay of syndemic variables (Tsai & Burns, 2015). In a systematic review, the authors discuss that most of the papers that used only the count variable had smaller sample sizes than the studies that attempted to account for interactions (Tsai & Burns, 2015). At least one study was mentioned in the systematic review which used RERI, similar to the suggested techniques for measurement of intersectionality. Papers like that of Herrick (2011) use interactions in order to avoid the assumption that all psychosocial issues influence the syndemic and outcome variables equally (A. Laurel Herrick, 2011; Tsai & Burns, 2015). Given these guidelines, it is advisable that syndemic studies have a large enough sample size to include interaction variables or RERI.

### 1.1.3 Collective Action about HIV Transmission

In his 1976 discussion of social justice and public health, Beauchamp believed that collective actions should be developed once public health professionals understand the hazards of death and disease. These actions are to be imposed through plans and organization of government or non-governmental agencies who make actions non-voluntary, including structural changes (Beauchamp, 1976). Non-voluntary participation by individuals, states and localities has proven to be easier said than done.

#### 1.1.3.1 The HIV Care Continuum

Perhaps one of the most collective actions to date in terms of HIV care and treatment has been the debut of the HIV care continuum (CC) and the National HIV/AIDS Strategy (Millett et al., 2010). A seminal paper by Gardner and colleagues (2010), discussed the HIV CC as a cascade, which described five phases of HIV care: (a) testing and diagnosis of HIV; (b) linkage to HIV care; (c) retention in care for HIV; (d) use of antiretroviral therapy and (e) the achievement of an undetectable viral load (E. M. Gardner et al., 2011). The study went on to identify areas where care and treatment systems must be improved to reduce transmission of HIV by ultimately reducing the collective community viral load (E. M. Gardner et al., 2011). Despite previous studies on linkage to care and early initiation of ART, this continuum became the predominant model for creating benchmarks and measuring outcomes (L. I. Gardner et al., 2005; Medland et al., 2015).

#### 1.1.3.2 The National HIV/AIDS Strategy

Concurrently, the Obama Administration released the National HIV/AIDS Strategy (NHAS) in 2010 with three broad objectives: (a) to reduce HIV incidence by 25% before the end of 2015; (b) to optimize healthcare outcomes for people living with HIV by increasing healthcare access; and (c) to reduce disparities related to HIV (Millett et al., 2010). Beyond these objectives, the strategy outlined prevention tools at each level of the social ecology for seronegative and seropositive individuals (Millett et al., 2010). This strategy allowed for the selection of primary populations for intervention and increased funding. At the time of the strategy's development, the CDC estimated that of the more than one million Americans living with HIV, approximately 80% had been diagnosed, but only 62% were linked to HIV care; only 41% had been retained in care over the past year; only 36% were currently receiving ART, leaving only 28% with an undetectable viral load (Valdiserri, 2012).

An initial evaluation of the NHAS found that it was more focused and practical than previous attempts by US presidents to address HIV (Yehia & Frank, 2011). The strategy chose admirable goals, but it took much longer than expected adequately fund each objective, including HIV screening and care for those newly diagnosed or those returning to care (Yehia & Frank, 2011). The strategy was successful, however, in clarifying populations of interest for intervention such as gay and bisexual MSM, Blacks, Latinos, and intravenous substance users. The strategy also encouraged the use of the continuum among the federal, state and mostly urban local governments and municipalities to monitor their progress on cascade targets (Medland et al., 2015; Valdiserri, 2012). This widely accepted framework allowed researchers and practitioners alike to focus on improvements to each step of the continuum while measuring

successes and challenges (Bhatia, Hartman, Kallen, Graham, & Giordano, 2011; Hull, Wu, & Montaner, 2012; Mugavero, Amico, Horn, & Thompson, 2013; Sullivan et al., 2012a).

#### 1.1.3.3 HIV Prevention Continuum

Similar to the HIV care continuum, researchers proposed a prevention continuum in 2014 (McNairy & El-Sadr, 2014). The continuum contained four phases for individuals who are HIV negative : (a) testing for HIV; (b) linkage to HIV prevention tools such as PrEP and risk reduction counseling; (c) ongoing support for prevention retention; and (d) repeat testing/adherence for biomedical prevention (McNairy & El-Sadr, 2014). Researchers and practitioners are using the continuum to encourage HIV prevention and at least one study in Atlanta has used it as a model to study uptake of PrEP among Black and White MSM based on their healthcare access and behavior (Kelley et al., 2015).

#### 1.1.3.4 Toward thinking about Comprehensive Biobehavioral HIV Prevention among BMSM

While the HIV care continuum and the prevention continuum target different groups, these groups are often interrelated. MSM who may test HIV negative several times may still shift from the prevention continuum to the care continuum; MSM seeking relationships may ultimately develop a serodiscordant relationship where PrEP and TasP are essential tools for limiting HIV transmission (McNairy & El-Sadr, 2014). The use of both of these models is essential in moving the needle of HIV prevention and treatment among MSM, especially BMSM (McNairy & El-Sadr, 2014). Figure 1-1 offers an example of how these continua may be viewed in conjunction with one another.

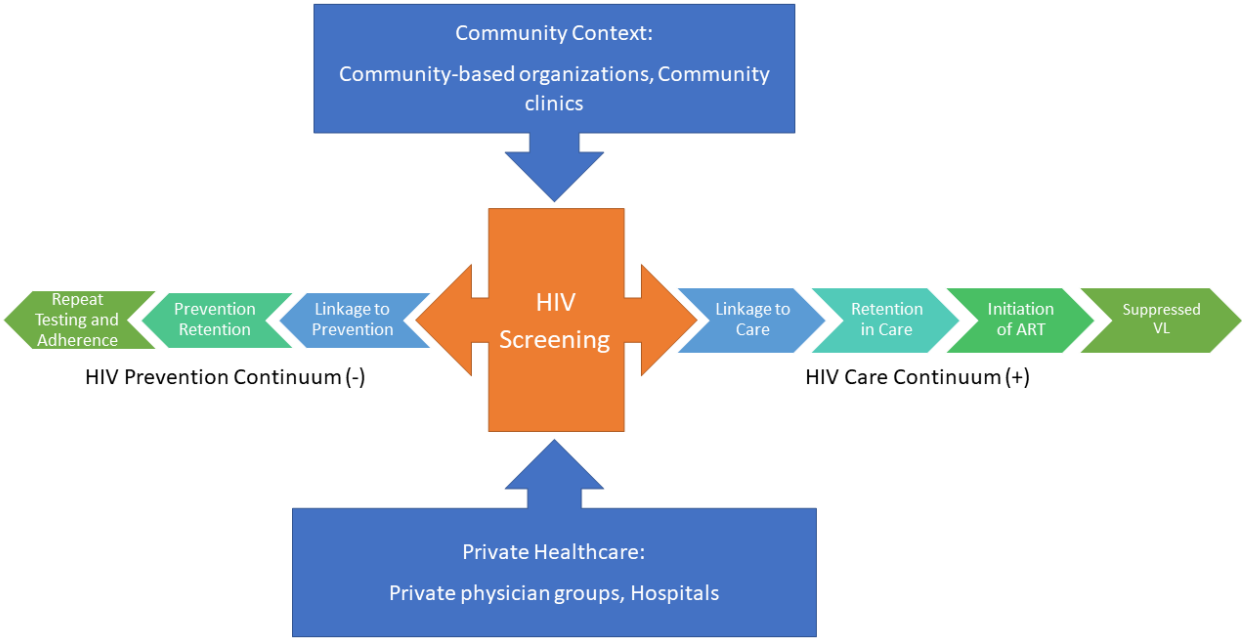


**Figure 1-1 Modeling Comprehensive Biobehavioral HIV Prevention Continua**

### 1.1.4 Equitable Sharing of Costs and Benefits

The social justice approach used by public health is most critical in developing equitable costs and benefits for the population. This is the greatest difference between market justice and social justice approaches. The sustainability and impact of public health strategies are partially based on the ability to resource the collective actions that are most applicable for each group, particularly those most marginalized.

Beauchamp (1976) discusses the need for equitable sharing of costs and benefits as a principle of social justice with the exception of when one or more groups is disadvantaged and susceptible to death or disease (Beauchamp, 1976). As the development of the HIV care continuum took shape in 2010, the Obama Administration released two targeted documents: the National HIV/AIDS Strategy and the National HIV/AIDS Strategy Implementation Plan (Millett et al., 2010). These documents outlined the vision of the strategy: "The United States will

become a place where new HIV infections are rare and when they do occur, every person regardless of age, gender, race/ethnicity, sexual orientation, gender identity or socio-economic circumstance, will have unfettered access to high quality, life-extending care, free from stigma and discrimination" (White House Office of National HIV/AIDS Policy, 2017). Strengthening the commitment to HIV treatment access, the Obama Administration released several executive orders detailing funding priorities in an effort to structurally address the urgent needs of priority populations seen as the most impacted by HIV (Skarbinski et al., 2015). The Obama Administration also released presidential memoranda that identified the Departments of Health and Human Services, Labor, Veterans Affairs, Housing and Urban Development, Justice and the Social Security Administration as lead agencies in the HIV strategy (Millett et al., 2010).

One of the most dramatic shifts in the HIV cascade was the necessary increase in HIV care and access that would be required to meet the targets of the strategy. One achievement of the Patient Protection and Affordable Care Act (ACA) was the expansion of Medicaid and access for many people, particularly BMSM, who were newly diagnosed during strategy implementation (Skarbinski et al., 2015). A recent statistical analysis using a static, deterministic model demonstrates that simulated sequential achievement along the cascade of care continuum was associated with reduced HIV transmission rates (Skarbinski et al., 2015). Ultimately, for the goals of the updated national strategy to be achieved, access must continually be improved, ensuring that there is no lack of access to HIV treatment or to PrEP for BMSM.

## 1.2 CONCLUSION

Given that BMSM bear a disproportional burden of HIV infection, understanding the unique needs to intervene in the HIV epidemic among BMSM requires additional research. While the disparity in seroconversions has been happening for at least two decades, BMSM have not been the focus of most of the HIV prevention and treatment research within the United States. Most of the studies published were subsamples of larger studies, with little power to study the nuances and differences that made the epidemic among BMSM unique.

The imperative of social justice within public health points to a history of systemic challenges in adapting and addressing the concerns among this most impacted group. The addition of intersectionality allows public health researchers to amplify studies detailed in experiences of BMSM and tailor interventions for BMSM, rather than the traditional comparison to White MSM. By focusing only on BMSM, research can uncover subpopulations that demonstrate otherwise overlooked challenges and opportunities.

In reforming the ways in which research conceptualizes the interplay of social ecology, social oppressions and healthcare outcomes, syndemics can provide a basis to study the current epidemiological quandary that is BMSM. By providing a framework for multiple contributing factors, future inquires must strive to reveal predictors of marginalization and their impacts on prevention and care outcomes.

This dissertation contributes to the ongoing research by focusing on biobehavioral techniques of HIV suppression in the context of the psychosocial issues that BMSM face across the United States. One of the primary driving forces of the epidemic among BMSM is the number of BMSM who are unaware of their own status as well as unaware of their partners' status. Using HIV screening as a gateway to public health interventions, a logical inquiry is

compliance of HIV seronegative or unknown status BMSM with CDC recommendations on HIV testing. The CDC recommendation of HIV testing in six month intervals yields two paths of equal value: (a) HIV risk determination as a tool for guiding BMSM through the HIV prevention continuum and (b) HIV diagnosis, ushering BMSM through the HIV care continuum.

For HIV-negative BMSM, the development of PrEP as a tool within the prevention continuum has the potential to reduce new infections among BMSM, yet little is known outside of clinical studies about the uptake and use of PrEP my BMSM. If BMSM continue to lag behind other MSM in PrEP uptake, there is a potential to exacerbate current disparities. Understanding how BMSM who are currently using PrEP may be different from other BMSM with similar risk is critical to ensuring the diffusion of this innovation and the use of future biomedical innovations.

As the majority of models and estimates of HIV infections among BMSM converge on a greater than or equal to 50% lifetime risk for seroconversion, a primary factor of intervention must be on biobehavioral HIV prevention among BMSM living with HIV. Ensuring that BMSM are being treated and retained in care through the suppression of viral load is critical in slowing incidence and prevalence of HIV. Increasing the number of BMSM at all levels of the care continuum requires addressing challenges at each step, beginning with the expectation of linkage in the first 90 days following diagnosis. The contribution of syndemic factors to BMSM retention in care must be studied, given that if the theory is correct, BMSM facing a constellation of challenges will not be retained and may ultimately transmit the virus. Failing to successfully assist BMSM arrive at undetectable status disrupts the underlying goal of reducing the community viral load and the disparity it represents.

# 2.0 CURRENT DISSERTATION RESEARCH

This dissertation addresses current gaps in the HIV literature regarding HIV screening, biomedical prevention uptake and treatment for BMSM. Data analyses were conducted using the Promoting Our Worth, Resilience and Equality (POWER) study, collected by the Center for LGBT Health Research at the University of Pittsburgh with funding from the National Institute of Nursing (NIN). The study collected data from 88 national Black Pride events from 2014 through 2017. With support from the Center for Black Equity (CBE), researchers collected data using time-location sampling at randomized events selected from all possible events. Cross-sectional sociodemographic and behavioral information was collected using audio computer-assisted self-interviews (ACASI) with biological confirmation of HIV status of consenting participants. Eligibility for POWER included individuals age 18 and over, self-identified as male at birth regardless of gender status, and history of ever having anal sex with a male. The benefit of this data-rich study is the ability to assess the behavioral and social lives of BMSM while understanding any possible synergy of the variables.

Combining the cross-sectional data and syndemics framework, the first analysis explores the effect of syndemic factors on HIV screening outcomes of seronegative BMSM. The second analysis builds on the HIV prevention continuum by comparing the use of PrEP among BMSM who report PrEP-eligible behavioral risk as defined by the CDC with those who reported using PrEP at the time of the study (U.S. Department of Health and Human Services. Centers for

Disease Control and Prevention, 2012). In the third analysis, literature on BMSM living with HIV is expanded by exploring the effect of syndemic variables on whether participants were in care or using antiretroviral therapy (ART) for HIV. The analysis also seeks to explore the relationship between time of linkage post HIV diagnosis and undetectable status.

In addition to advancing the literature, this dissertation has two primary strengths. In response to the often small sample sizes of BMSM in previous studies, the POWER study contains data from 5,858 BMSM and transwomen, providing one of the largest field-collected samples in this population known to date. Additionally, in response to critiques of previous literature, this dissertation includes the demonstration of the additive interplay of syndemic variables in addition to measures of the interaction between variables. Using these three indices, the relative excess risk due to interaction (RERI), the attributable proportion to the interaction (AP), and synergy index (S), this dissertation will be only the second set of analyses to describe such interactions among syndemic variables (Tsai & Burns, 2015).

## 2.1 ANALYSIS 1: AIMS AND HYPOTHESES

Aim 1: Explore any underlying sociodemographic differences in HIV screening within the previous six months among a national sample of seronegative Black MSM.

Hypothesis 1.1: Given that the extant literature suggests that young MSM have been less likely to be tested in previous studies and are less likely than other MSM to know their HIV status, it is hypothesized that BMSM under age 30 will have lower odds than those over 30 of being tested in the previous six months in bivariate analyses.

Aim 2: Explore if the number of psychosocial issues (hereafter considered a syndemic) influences the HIV screening of seronegative Black MSM within the previous six months.

Hypothesis 1.2: Theoretically, the presence of a syndemic would suggest that BMSM will have lower odds of being tested for HIV within the previous six months at each increasing level of co-occurring psychosocial issue (syndemic) count.

## 2.2 ANLAYSIS 2: AIMS AND HYPOTHESES

Aim 1: Explore sociodemographic differences among seronegative BMSM using Pre-exposure Prophylaxis (PrEP) and BMSM who are behaviorally eligible but not using PrEP.

Hypothesis 2.1: BMSM not using PrEP will have lower odds of reporting current health insurance coverage.

Aim 2: Explore HIV risk behavior differences between seronegative BMSM using PrEP and those not using PrEP based on five CDC HIV risk conditions.

Hypothesis 2.2: BMSM that report using PrEP will have higher odds reporting the five behavioral risk factors noted by the CDC PrEP guidelines.

Aim 3: Explore if the number of syndemic factors experienced by seronegative BMSM using has an effect on reporting current PrEP use.

Hypothesis 2.3: BMSM will be less likely to report PrEP use at each increasing level of syndemic variable count.

## 2.3 ANALYSIS 3: AIMS AND HYPOTHESES

Aim 1: Determine if the presence of a syndemic predict being in care for HIV among BMSM

Hypothesis 3.1: BMSM will have lower odds of being in care at the time of survey at each increasing level of syndemic variable count.

Aim 2: Determine if the presence of a syndemic predicts antiretroviral treatment (ART) adherence among a sample of BMSM.

Hypothesis 3.2: BMSM will have lower odds of being adherent to ART at each increasing level of syndemic variable count.

Aim 3: Determine if the time between HIV diagnosis and linkage to medical care for HIV is associated with an undetectable viral load.

Hypothesis 3.3: BMSM that were linked to HIV medical care within 90 days or less will have higher odds of being undetectable than BMSM linked to medical HIV care after 90 days or more.

# 3.0 HIV SCREENING PATTERNS OF BLACK MSM ATTENDING BLACK PRIDE EVENTS AND THEIR ADHERENCE TO CDC HIV SCREENING RECOMMENDATIONS IN THE PREVIOUS SIX MONTHS

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## 3.1 INTRODUCTION

Since the Obama Administration released the National HIV/AIDS strategy in 2010, there have been considerable changes to the framing of HIV treatment and care (Millett et al., 2010). With the focus of HIV viral suppression and elimination of transmission as goals of the new strategy, there was a renewed commitment to testing populations most at risk for HIV; chief among these groups are Black MSM, especially Black young men who have sex with men (BYMSM) under age 30 (Millett et al., 2010). Current Centers for Disease Control and Prevention (CDC) estimates concluded that there is a 1 in 2 lifetime risk for BMSM to be diagnosed with HIV (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 2014a). In order to reduce HIV transmission, public health systems need to assure individuals with HIV

are diagnosed and successfully engaged in treatment while simultaneously encouraging HIV seronegative men to remain negative (Haire & Kaldor, 2013).

Historically, research on the likelihood of HIV transmission among BMSM found that infrequent testing allowed BMSM to transmit the virus for longer periods than other MSM, therefore initiation of antiretroviral therapy (ART) as soon as possible is optimal (Christopoulos, Das, & Colfax, 2011; Millett et al., 2007). BYMSM have had the highest incidence rates among all young MSM (ages 13-29) since 2006 (Maulsby et al., 2014; Scott et al., 2014). Between 2006 and 2009, there was a 48% increase in the incidence of HIV among YBMSM (Prejean et al., 2011). One HIV screening study of six urban areas found that 77% of all young MSM in the sample were previously unaware of their HIV infection, and that 91% of the YBMSM in the sample were not previously diagnosed (MacKellar et al., 2005). These data support the later analysis of Zanoni and Mayer (2014) that estimated that only 40% of HIV infections in people under 30 were diagnosed (Zanoni & Mayer, 2014). Their study went on to explain that normalizing HIV testing among youth, particularly YBMSM, was of particular importance (Zanoni & Mayer, 2014). In 2008, CDC suggested recommendations for HIV testing, which included screening every six months for MSM and annually for all others aged 15-64 (Branson et al., 2006; U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 2011). HIV screening is essential to limiting HIV transmission and is the first stage in the HIV cascade of care (E. M. Gardner et al., 2011).

Soon after the CDC testing strategy was released, treatment regimens shifted to a *test and treat model*, where individuals were encouraged to begin antiretroviral treatment immediately rather than waiting until the individual reached biological criteria indicating a reduced immune response (J. Cohen, 2011; Dodd, Garnett, & Hallett, 2010; E. M. Gardner et al., 2011; Walensky

et al., 2010). For BMSM living with HIV, the goal shifted to continually suppressing HIV so that those living with HIV would become undetectable and thereby have an almost zero chance of transmission to partners. Concurrently, in 2012, the US Food and Drug Administration approved the use of a reverse transcriptase inhibitor combination of tenofovir disoprixil fumarate and emtricitabine known as Truvada® for daily use as prevention for seronegative individuals with demonstrated HIV risk (Grant et al., 2010; Krakower et al., 2012). Titled pre-exposure prophylaxis (PrEP), while this mediation required a prescription and ongoing medical follow-up, it began a biomedical prevention revolution.

Regardless of the serostatus of BMSM, a requisite step to addressing HIV transmission and viral suppression among this group is routine screening for HIV diagnosis. For men who are negative but exhibit risk, screening represents an opportunity to introduce prevention tools, while men who are diagnosed can be linked to care. Given the important nature of ensuring BMSM are aware of these HIV transmission prevention methods, the first research question of this dissertation is focused on HIV screening.

Much of the current literature related to HIV transmission and biobehavioral intervention is grounded in the study of HIV risk behavior. One method that has been used to study HIV in various communities, including MSM has been the use of the theory of syndemic production. Syndemics occur when several epidemics occur simultaneously and work synergistically with risk factors to worsen health outcomes (Parsons, Grov, & Golub, 2012; Singer, 1994; Stall et al., 2003). Originally derived from biological events, such as co-morbidities, syndemics expanded to include biological and ecological factors that impacted health outcomes, such as psychosocial factors that had been independently associated with HIV risk or HIV seroconversion. Stall and colleagues (2003) began to quantitatively model this phenomena by the inclusion of a syndemic

count variable, where the study found increasing reports of risk behavior with increasing numbers of psychosocial factors among the MSM participating in the research. Several studies replicated this method among urban MSM, usually with small numbers of non-White MSM. The psychosocial factors most often used in these syndemic count variable analyses consist broadly of polysubstance use, violence, depression symptomologies and sexual risk with outcome variables of HIV risk activity or seroconversion (Tsai & Burns, 2015).

Promoting Our Worth Equality and Resilience (POWER), an NIH-sponsored study of the University of Pittsburgh conducted a cross-sectional national study of MSM and transgender women at national Black Pride events between 2014 and 2017. POWER specifically sought to collect a large enough sample to explore the use of syndemic theory in relation to the HIV disparity among BMSM and other MSM. Although syndemic theory has most often been used to study psychosocial challenges in relation to HIV transmission risk behavior or HIV infection in a group (Tsai & Burns, 2015), this study seeks to examine the impact of the most noted syndemic variables on seronegative BMSM behavior concerning HIV screening. Such an analysis is being used to explore syndemics and if the same syndemic variables that have been salient for groups of mostly White MSM are the same for BMSM. To the best of the researcher's knowledge, this will be the first research study to use a syndemic model to explore the outcome of the CDC recommended screening among BMSM. Based on previous literature, it is hypothesized that BYMSM will be less likely than older MSM to have been tested in the previous six months and that BMSM in the sample will be less likely to be tested at increasing levels of psychosocial issue counts (syndemics).

## 3.2 METHODS

### 3.2.1 Eligibility, Recruitment and Study Procedures

#### 3.2.1.1 Eligibility

A community-based sample of 5,858 MSM and transwomen participated in the cross-sectional survey over the four-year study period (2014-2017). Men were eligible to participate in the study if they were: 1) 18 years old or older; 2) had anal sex with at least one male in the last 12 months; 3) did not identify as transgender; 4) were of HIV negative or unknown status (at the time of the survey); and 5) identified as Black. The analytic sample for the current study is 3,294 BMSM. Due to the unique experiences of transwomen, they were not included in this analysis but are the subject of other analyses.

#### 3.2.1.2 Recruitment

Participants were recruited at national Black Pride events in six cities across the country. Events were selected via a random digit lottery in order to use time-location sampling (TLS) for analysis within city-specific studies as described previous literature (Karon & Wejnert, 2014; Kendall et al., 2008). Recruitment included indoor and outdoor events, as well as venues such as late night bars and nightclubs. Staff recruiters assessed each participant's ability to consent to the study.

#### 3.2.1.3 Study Procedures

The study used Windows-based tablets with the audio computer-assisted self-interviewer (ACASI) system. Each tablet provided a primary screener and documented consent from each participant. The researchers of this study obtained a waiver of written consent from the local

university's institutional review board in order to obtain anonymous results. The 25-minute survey assessed demographic variables, sexual risk, and psychosocial variable results (e.g. depression). Participants were compensated $10 for their participation.

### 3.2.2 Measures

#### 3.2.2.1 Outcome Variable

In order to study the adherence of participants to the CDC 2006 HIV screening recommendations, which suggest that sexually-active MSM should be tested for HIV every six months, a dichotomous outcome variable was assessed with the following question: *"Have you been tested for HIV in the past 6 months?"* Dichotomous responses (yes, no) in addition to "Don't know" and "Refuse to answer" were included. Answers "Don't know" and "Refused to answer" responses were recoded as missing. There were 27 cases with missing data.

#### 3.2.2.2 Demographic Variables

Participants reported their age category, income, sexual orientation (sexuality), and employment status as seen in Table 1. Participant responded were recoded into three age categories for adults: YMSM 18-29 (0), MSM 30-39 (1) and MSM 40 and over (2). Income was dichotomized below and up to the median (0) and above the median (1). Sexual orientation was collected as four categories: "gay/same gender loving" (0), "heterosexual or 'straight'" (1), "bisexual" (2) and "other" (3). Insurance coverage was asked by a single question in this analysis: *"Do you currently have health insurance or health care coverage?"* Dichotomous (yes, no) responses were recorded in addition to "don't know" and "refuse to answer." For all demographic

variables, answer choices “Don’t know” and “Refused to answer” were recoded as missing. All other variables used for analysis were also included in Table 3-1 for reference.

#### 3.2.2.3 Psychosocial Issue (Syndemic) Variables

A total of five variables were considered to contribute to a syndemic for analysis. For each variable, questions were isolated relating to the psychosocial issue and recoded as necessary. Comparisons of syndemic variables is found in Table 3-1.

##### *Poly Substance Use*

Substance use was captured in this study using a two-step process. First, a single question determined if participants had used any recreational substances in the past year: “*In the past 12 months, have you used recreational drugs?”* with dichotomous responses (yes, no) in addition to “Don’t know” and “Refuse to answer” which were recoded as missing. Second, poly substance use was defined as the use of three or more substances as described in previous literature (Mimiaga et al., 2015; Stall et al., 2003). Substances included in the measure were: cocaine, crack, heroin, opiates, crystal meth, inhalants (e.g. “poppers”) and other party drugs. Poly substance questions asked if the participants had used these substances in the past three months. Results were recoded to dichotomous responses (yes, no). The summation of the number of substances used were recoded into poly substance use as three or more (yes) or less than three substances (no) with responses of “Don’t know” or “Refused to answer” were recoded as missing.

### *Depression*

Depression was assessed using the CESD-10, which screens for past-week depressive symptoms. The CESD-10 is comprised of 10 questions, including three questions which are reverse-coded, which were summed. A total score of 10 or more of a possible 30 was used to indicate likelihood of moderate to severe depression as previously demonstrated in literature (Andresen, Malmgren, Carter, & Patrick, 1994).

### *Intimate Partner Violence*

Intimate Partner Violence (IPV) was assessed using a single question: "*In the past year, have you been in a relationship with a partner who has ever hit, kicked, slapped, beaten or in any other way physically assaulted you?*" Dichotomous (yes, no) responses were provided in addition to "Don't know" and "Refuse to answer" which were recoded as missing.

### *Problematic Binge Drinking*

Binge drinking, defined as five or more drinks in one sitting, was measured by a single question in this analysis: "*In the past 12 months, how often did you have 5 or more alcoholic drinks in one sitting?"* Time responses were provided on a scale from "never" to "more than once a day." Binge drinking was used as a dichotomous (yes, no) variable to determine if the participant was considered to have problematic drinking (more than one binge drinking episode per month) as seen in previous literature (Jie, Ciyong, Xueqing, Hui, & Lingyao, 2012; Wong, Kipke, & Weiss, 2008)

### *Sexual Risk*

This analysis used a number of factors of HIV risk as proxies of sexual risk in keeping with the current CDC guidelines for the consideration of Pre-Exposure Prophylaxis. While this study is not specific to men using PrEP, PrEP guidelines are written for seronegative men who have demonstrated HIV risk in the recent past; therefore this sexual risk variable is a confluence of those factors (Smith et al., 2014). A total of 13 questions were used to develop this dichotomous risk variable (0 = less to no risk, 1 = greater risk) based on five criteria used in CDC risk determination: recent HIV positive sexual partner, recent bacterial sexually transmitted infection (STI), history of condom use, number of sexual partners and history of sex work. To achieve the most conservative estimates, participants were considered at greater risk if they reported any of the risk factors listed. Three of these criteria, recent positive partner, recent bacterial STI and participation in sex work, were dichotomous (yes, no). The other two were recoded to be dichotomous. For number of sexual partners, the question *"In the past 12 months, with approximately how many different men have you had anal sex?"* was dichotomized at three partners or more as seen in previous literature. BMSM hypothesized to have "greater risk" were those with more than three partners (1), while men with three partners or less were considered "lower risk" (0). Lastly, participants were asked, *"Of the times you had receptive anal sex (bottomed), what proportion of the time did your partner wear a condom?"* and *"Of the times you had insertive anal sex (topped), what proportion of the time did you wear a condom?"* with responses ranging from "never" (0) to "always" (4). Participants who reported condom use half of the time (2) or less were considered to have more risk.

### 3.2.3 Analytic Procedure

All analyses were completed in Stata 14.2 (Stata Corp, College Station, TX) using the following steps. Listwise deletion was used for missing information including 27 participants who did not have complete information for psychosocial variables or the outcome variable. Bivariate logistic analyses were conducted in order to determine the relationship of each of the psychosocial variables with the dependent variable (HIV testing within the last six months) as seen in Table 3-2. Table 3-2 also shows the impact of the demographic variables on HIV testing within the last six months prior to survey. Lastly, a stepwise logistic regression with the number of syndemic variable counts, controlling for demographic variables was conducted (Table 3-3) to understand if there was an additive interplay of syndemic variables that contributed to differences in testing within the previous six months.

To respond to critiques that the syndemic count variable may oversimplify the model by displaying only additive results and to express the synergy of variables, three indices of interaction are being computed among the syndemic variables (Tsai & Burns, 2015). The relative excess risk of the interaction (RERI), attributable proportion due to the interaction (AP) and the synergy index (S) are being presented in 2-way interactions. First discussed as a way to assess biological interactions in epidemiology, it has been suggested that these measures of interaction (also known as joint effects) are appropriate for modeling the combined impact of experiences on behavior with AP as a more robust measure than RERI when using odds ratios (OR) (Hosmer & Lemeshow, 1992; Kalilani & Atashili, 2006; Rothman, Greenland, & Walker, 1980). These approaches were supported specifically in syndemics studies by a systematic review that recommends the use of RERI, AP and S as useful ways to show departure for additivity (Tsai & Burns, 2015). The first, RERI, is the difference between the observed OR and the expected OR

for the syndemic variables being compared (null value = 0). The second index, AP, is the proportion of the RERI to the observed OR when both syndemic variables are present (null value = 0); and the third index, S, is the ratio of risk due to exposure for both variables when there is and is not synergy (null value = 1). These measures of interaction are displayed in Table 3-4. The formulas for these calculations are as follows:

$$RERI = OR_{A-b-} - OR_{A+b-} - OR_{A-b+} + OR_{A+b+} \quad \text{equation 1}$$

$$AP = (OR_{A-b-} - OR_{A+b-} - OR_{A-b+} + OR_{A+b+}) / OR_{A+b+} \quad \text{equation 2}$$

$$S = (OR_{A+b+} - OR_{A-b-}) / ((OR_{A+b-} - 1) + (OR_{A-b+} - 1)) \quad \text{equation 3}$$

**Figure 3-1 Formulas for Indices of Interaction and Synergism for Syndemic Variables**

## 3.3 RESULTS

Demographic characteristics of the sample stratified by outcome variable are presented in Table 3-1. A majority of the sample were YMSM (64.2%) and the majority also identified as gay/homosexual (79.7%). Just over half of the sample (55.7%) had annual income that was greater than or equal to $30,000 and the majority had some college education or were college graduates (59.9%). Most of the sample was single at the time of survey (74.7%) and most had health insurance (83.5%). Relationship status and sexual orientation did not appear to differ significantly when comparing those tested to those not tested in the six months prior to survey.

In bivariate analyses, found in Table 3-2, BYMSM (OR = 2.14, 95% CI: 1.73, 2.64) and BMSM aged 30-39 (OR = 1.79, 95% CI: 1.39, 2.25) were significantly more likely to have been tested than BMSM 40 and older. Participants who earned $30,000 or more annually were more likely to have been tested in the last six months (OR = 1.35, 95% CI: 1.17, 1.56), as were men

who were college educated (OR = 1.70, 95% CI: 1.44, 2.01) or had post-baccalaureate or graduate education (1.45, 95% CI: 1.14, 1.85) as compared to men with a high school education or less. Men who did not have insurance at the time of the survey were less likely to have been tested in the last six months (OR = .73, 95% CI: 0.61, 0.88) compared to those with insurance. Among the syndemic variables, only those with higher HIV risk were significantly more likely to have been tested in the previous six months (OR = 1.20, 95% CI: 1.01, 1.41).

A standard, stepwise logistic regression was performed to assess whether participants had been tested for HIV within the previous six months as predicted by number of psychosocial issues (syndemic), including: problematic drinking, poly drug use, past year intimate partner violence, depression and sexual risk, while controlling for age, sexual orientation, income, education, relationship status and current insurance coverage. There were 6 levels of the syndemic count variable (0 to 5 psychosocial issues).

Table 3-3 displays the results of the logistic regressions. Model 1 contains the multivariable results of the demographic variables. Model 2 contains the results of syndemic variable counts controlling for demographic variables, showing that men with one (AOR = 1.35, 95% CI: 1.03, 1.77) or two (AOR = 1.37, 95% CI: 1.04, 1.80) syndemic variables were statistically more likely to be tested for HIV in the last six months than men with no issues. There were no significant associations for men who had three or more syndemic variables in this sample, although all estimates of the AOR were greater than the null value (null = 1). To further examine this phenomenon, model 3 contains a dichotomous “any syndemic” variable, comparing BMSM without a syndemic (0-1 issues) and BMSM with two or more issues. While the estimated AOR for model 3 is above the null value, it was not significant.

Table 3-4 displays the results of the tests of joint effects resulting in RERI, AP and S. In order to aid in the understanding of these data, the outcome variable of HIV testing in the previous six months was reverse coded (0 = Yes, 1=No). As HIV screening is a form of secondary prevention, extant literature dictates that preventative factors should be reverse coded (Knol et al., 2011). All RERI and AP with greater than zero were considered to have a greater than additive effect, while a negative value for RERI or AP indicates less than additive (Knol et al., 2011). There were four instances of synergy among syndemic variables that resulted in higher odds of not being screened in the last six months: poly drug use and depression (AP = 0.01, S = 1.02), sexual risk and problematic drinking (AP = 0.17, S = 1.98), poly drug use and problematic drinking (AP = 0.16, S = 3.70) and problematic drinking use and depression (AP = 0.16, S = 3.70).

**Table 3-1 Demographic and Syndemic Variables of Negative BMSM by Previous Six Month Screening Status in the POWER Sample 2014-2017 (N =3,297)**

| | Report HIV screening in past six months? | | |
|---|---|---|---|
| Demographic Variable | No (n = 1,097) | Yes (n = 2,170) | $X^2$ Variance |
| Age | | | 51.6, p<.001* |
| 18-29 | 636 (58.0) | 1464 (67.5) | |
| 30 – 39 | 253 (23.0) | 482 (22.2) | |
| 40+ | 208 (19.0) | 224 (10.3) | |
| Sexuality | | | 4.0, p=.261 |
| Gay/Homosexual | 857 (78.2) | 1745 (80.5) | |
| Heterosexual | 13 (1.2) | 17 (0.78) | |
| Bisexual | 205 (18.7) | 378 (17.4) | |
| Other | 21 (1.9) | 29 (1.3) | |
| Annual Income | | | 16.5, p<.001* |
| $0-29,999 | 525 (48.5) | 884 (41.0) | |
| $30,000+ | 551 (51.5) | 1273 (59.0) | |
| Education | | | 39.5, p<.001* |
| High school or less | 361 (33.0) | 498 (23.0) | |
| Some college or college | 558 (53.8) | 1379 (63.7) | |
| Post Bac/Graduate | 144 (13.2) | 289 (13.3) | |
| Relationship status | | | 2.2, p=.139 |
| Single | 802 (75.0) | 1648 (77.3) | |
| Partnered | 267 (25.0) | 482 (22.6) | |
| Current Insurance | | | |
| Yes | 882 (80.5) | 1843 (84.9) | 10.5, p=.001* |
| No | 214 (19.5) | 327 (15.1) | |
| Syndemic Variables | | | |
| 3-month Poly Drug Use (3 or more) | | | 2.0, p=.157 |
| No (0) | 1055 (96.2) | 2107 (97.1) | |
| Yes (1) | 42 (3.8) | 63 (2.9) | |
| Depression (CESD-10) | | | 3.3, p=.070 |
| No (0) | 644 (58.7) | 1345 (62.0) | |
| Yes (1) | 453 (41.3) | 825 (38.0) | |
| Intimate Partner Violence (12 months) | | | 3.1, p=.080 |
| No (0) | 938 (85.6) | 1803 (83.2) | |
| Yes (1) | 158 (14.4) | 364 (16.8) | |
| HIV Risk (12 months) | | | 4.1, p=.042* |
| Low Risk | 285 (26.0) | 494 (22.8) | |
| High Risk | 812 (74.0) | 1676 (77.2) | |
| Problematic Drinking | | | 0.978, p=.323 |
| No (0) | 669 (61.0) | 1360 (62.2) | |
| Yes (1) | 427 (39.0) | 805 (34.8) | |

*p<.05

**Table 3-2 Analysis of Seronegative BMSM in POWER Reporting an HIV Test in the Previous Six Months in the POWER Sample, 2014-2017 (n=2,170)**

| Demographic Variable | Odds Ratio | 95% Confidence Interval |
|---|---|---|
| Age | | |
| 18 – 29 | 2.14* | 1.73 – 2.64 |
| 30 – 39 | 1.79* | 1.39 – 2.25 |
| 40+ (ref) | 1.0 | |
| Sexuality | | |
| Gay/Homosexual (ref) | 1.0 | |
| Heterosexual | 0.64 | 0.31 – 1.33 |
| Bisexual | 0.91 | 0.75 – 1.09 |
| Other | 0.68 | 0.38 – 1.20 |
| Annual Income | | |
| $0-29,999 | 1.0 | |
| $30,000+ | 1.35* | 1.17 – 1.56 |
| Education | | |
| High school or less | 1.00 | |
| Some college or college | 1.70* | 1.44 – 2.01 |
| Post Bac/Graduate | 1.45* | 1.14 – 1.85 |
| Relationship status | | |
| Single | 1.0 | |
| Partnered | 1.02 | 0.82 – 1.23 |
| Current Insurance | | |
| Yes (0) | 1.0 | |
| No (1) | 0.73* | 0.61 – 0.88 |
| Syndemic Variables | | |
| 3-month poly drug use (3 or more) | | |
| No (0) | 1.0 | |
| Yes (1) | 0.75 | 0.50 – 1.12 |
| Depression (CESD-10) | | |
| No (0) | 1.0 | |
| Yes (1) | 0.87 | 0.75 – 1.01 |
| Intimate Partner Violence (12 mts) | | |
| No (0) | 1.0 | |
| Yes (1) | 1.20 | 0.98 – 1.47 |
| HIV Risk (12 months) | | |
| Low Risk | 1.0 | |
| High Risk | 1.20* | 1.01 – 1.41 |
| Problematic Drinking | | |
| No (0) | 1.0 | |
| Yes (1) | 0.93 | 0.79 – 1.08 |
| Syndemic Presence (2+ issues) | | |
| No (0) | 1.0 | |
| Yes (1) | 0.99 | 0.92 – 1.07 |

*p<.05

**Table 3-3 Multivariable Analysis to Evaluate the Association of Syndemic Count and HIV Screening in the Previous Six Months in the POWER Sample, 2014-2017 (n = 2,170)**

| Model | Adjusted Odds Ratio | 95% CI |
|---|---|---|
| Model 1 (demographic variables) | | |
| Age | | |
| 18 – 29 | 2.18* | 1.74 – 2.72 |
| 30 – 39 | 1.68* | 1.30 – 2.16 |
| 40+ (ref) | 1.0 | |
| Sexuality | | |
| Gay/Homosexual (ref) | 1.0 | |
| Heterosexual | 1.04 | 0.49 – 2.21 |
| Bisexual | 0.97 | 0.80 – 1.19 |
| Other | 0.67 | 0.37 – 1.21 |
| Education | | |
| High school or less (ref) | 1.0 | |
| Some college or college | 1.51* | 1.26 – 1.81 |
| Post Bac/Graduate | 1.26 | 0.96 – 1.65 |
| Income | | |
| 0 – 29,999 (ref) | 1.0 | |
| 30,000+ | 1.26* | 1.06 – 1.50 |
| Relationship status | | |
| Single | 1.0 | |
| Partnered | 0.86 | 0.72 – 1.03 |
| Lack Insurance | | |
| No | 1.0 | |
| Yes | 0.76 | 0.70 – 1.34 |
| Model 2 (number of psychosocial issues) | | |
| Syndemic = 0 (ref) | 1.0 | |
| Syndemic = 1 | 1.35* | 1.03 – 1.77 |
| Syndemic = 2 | 1.37* | 1.04 – 1.80 |
| Syndemic = 3 | 1.24 | 0.91 – 1.69 |
| Syndemic = 4 | 1.58 | 0.98 – 2.53 |
| Syndemic = 5 | 1.03 | 0.70 – 3.10 |
| Model 3 | | |
| Any Syndemic (2+ issues) | 1.06 | 0.91 – 1.24 |

Note: all models were controlled for year and city of data collection in addition to demographic variables. Models 2 and 3 were conducted controlling for demographic variables. *p<.05

**Table 3-4 Analysis of Syndemic Variable Interaction for BMSM who did not Report HIV Screening in the Previous Six Months in the POWER Sample, 2014-2017 (n = 1,097)**

| | | Odds Ratio | | RERI | AP | S |
|---|---|---|---|---|---|---|
| | | Expected | Observed | | | |
| **Poly drug use** | **Depression** | **1.39** | **1.41** | **0.02** | **0.01** | **1.02** |
| Poly drug Use | Intimate Partner Violence | 1.60 | 1.00 | -0.59 | -0.59 | 0.01 |
| Depression | Intimate Partner Violence | 0.76 | 1.08 | 0.32 | 0.29 | -0.35 |
| **Depression** | **Problematic Drinking** | **1.07** | **1.27** | **0.20** | **0.16** | **3.70** |
| Depression | Sexual Risk | 0.75 | 0.93 | 0.18 | 0.20 | 0.28 |
| IPV | Sexual Risk | 0.74 | 0.72 | -0.01 | -0.02 | 1.06 |
| Intimate Partner Violence | Problematic Drinking | 1.00 | 0.91 | -0.09 | -0.10 | -29.49 |
| **Sexual Risk** | **Problematic Drinking** | **1.26** | **1.51** | **0.25** | **0.17** | **1.98** |
| **Poly drug use** | **Problematic Drinking** | **1.07** | **1.27** | **0.20** | **0.16** | **3.70** |

Note: due to the low prevalence of poly drug use in this sample, an analysis of joint effect and synergy between sexual risk and poly drug use could not be completed.

## 3.4 DISCUSSION

This study is the first to examine HIV screening using syndemic theory as well as one of the first to calculate measures of synergy among syndemic variables looking beyond additivity. Several important results were found in the analysis. The hypothesis that BYMSM were less likely to be screened in the previous six months when compared to older BMSM was not supported. BYMSM were significantly more likely have been tested in the past six months than BMSM aged 40 and over. This suggests that BYMSM are indeed being screened for HIV and that public health efforts to reach this group have been successful.

Second, in the multivariable logistic analysis, men who experienced one or two psychosocial issues were significantly more likely to have been screened in the previous six months than men who reported no issues. Although the estimates for men with greater than two

syndemic variables were not significant, they did indicate greater odds of being screened than BMSM reporting no issues. This may indicate that participants were being screened for HIV despite experiencing a cadre of syndemic factors, but there was not significant power to detect a difference. As these odds ratios demonstrated that men who were at risk were more likely to test, it may be possible that these most-used syndemic variables do not adequately explain the excess disease burden among BMSM.

Third, tests of the joint effects of variables and synergy were helpful in uncovering factors that contributed to a lack of testing and further revealed that, although the prevalence of poly drug use may have been low in the sample, experience of poly drug use did have synergy with depression and problematic drinking. Further, problematic drinking had synergy with depression, sexual risk and poly drug use. When poly drug use or problematic drinking are present with other factors, synergy is possible, but the results of the regressions do not indicate that these individual-level factors can entirely explain a lack of testing among BMSM. This may suggest that larger, structural factors are more influential in the HIV screening behavior of BMSM, particularly BYMSM and that public health investments in community-based testing have had an effect. This interpretation is consistent with at least one CDC study found that, despite universal clinical CDC screening recommendations, non-clinical settings found a greater number of diagnoses among Black individuals than clinical settings in 2013 (Seth, Wang, Collins, & Belcher, 2015).

Although this study has many strengths, such as the sample size, there are limitations to these data. POWER is cross-sectional in nature and relies heavily on self-report data which are subject to recall bias. Several of the syndemic variables were defined by a single question and it is possible that a single item was not exhaustive or provided a complete picture of the participant

experience. Depression symptomology was measured using a validated scale, however, due to the nature of depression, it is possible that those most depressed may have been less likely to attend social events where data were collected, and therefore may be underrepresented in these results. It is also possible that the results of the study may be subject to social desirability given the personal nature of many of the questions. The generalizability of the sample may be limited, although the data have been taken from a large, national sample at more than 80 venues within the United States. In terms of the calculation of synergy, while there are methods for calculating confidence intervals for RERI, AP and S, these calculations have been formulated primarily for use with datasets studying risk ratios rather than studies with odds ratios as the effect measure; therefore, determining statistical significance of these indices remains a challenge (Assmann, Hosmer, Lemeshow, & Mundt, 1996; A. Laurel Herrick, 2011; Richardson & Kaufman, 2009).

This study contributes novel information into the literature of BMSM by modeling the impact of syndemic variables on reports of HIV screening. The implications of these findings reiterate earlier studies which state that individual behavioral factors are not the primary contributor to HIV disparities among BMSM and other MSM. Additionally, this analysis highlights that poly substance use, while not very prevalent in this population, is an important predictor of not being screened when it has synergy with other variables. Lastly, this analysis provides a framework to study factors related to HIV prevention behaviors in other levels of the social ecology.

# 4.0 UNDERSTANDING THE IMPACT OF SYNDEMICS ON THE USE OF PRE-EXPOSURE PROPHYLAXIS IN A SAMPLE OF BMSM IN THE POWER STUDY

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## 4.1 INTRODUCTION

In 2012, the approval of Truvada® (a combination of emtricitabine (FTC) and tenofovir (TFV) disoproxil fumarate (TDF)) for daily use shaped a novel form of bio-behavioral HIV prevention among higher risk groups known as Pre-Exposure Prophylaxis (PrEP) (Grant et al., 2010; Haire & Kaldor, 2013). Currently, PrEP is prescribed for high risk groups including men who have sex with men (MSM), high-risk heterosexuals and intravenous substance users based on guidance from the Centers for Disease Control and Prevention (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 2012). So far, there is only one approved PrEP regimen, which is a single Truvada® tablet, taken once daily (Anderson et al., 2012). Several studies provided various estimates of HIV prevention including iPrEx, iPrEx OLE, PROUD and Project PrEPare ranging from a 44% reduction in HIV seroconversion with four or less doses per week to more than 90% with five or more doses per week. All of these studies

used closely monitored, clinically-based samples (Grant et al., 2014; Grant et al., 2010; Pérez-Figueroa et al., 2015). With the exception of two studies, black men who have sex with men (BMSM) tended to be underrepresented in the study populations (Brooks et al., 2015). At present, while many MSM are embracing PrEP as a prevention strategy, there is a disparity in both awareness and uptake of PrEP among BMSM (Brooks et al., 2015; Eaton et al., 2015).

In order to determine the best use of PrEP, beginning in 2011, the Centers for Disease Control and Prevention (CDC) developed a preliminary document outlining the most at-risk populations, the clinical and behavioral characteristics recommended for PrEP prescriptions and the ongoing healthcare maintenance recommended including quarterly HIV/STI screenings and creatinine clearance (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 2012). Those seeking to use this biomedical tool must obtain a prescription and maintenance from competent medical professionals. The cost of the medication and the associated care vary across states and municipalities, creating a patchwork of unequal access across the country. Early indicators show less uptake of PrEP among BMSM compared to their white counterparts, despite increases of awareness among BMSM (Brooks et al., 2015).

Understanding the unique circumstances leading to the stalled adoption of PrEP among BMSM is an ongoing consideration that must be addressed to make any further impact. The theory of syndemics has previously been used to understand the behavior of MSM based on their psychosocial experiences. A syndemic has been theorized as a group of interrelated epidemic and endemic factors that form a complex of crises that negatively affect health outcomes (Singer, 2000). As in chapter 3, this analysis sought to explore the impact of psychosocial issues on an HIV prevention strategy, with this analysis focused on PrEP. Building on the extant literature, the central hypothesis of this analysis is that BMSM not using PrEP would be less likely to

report current health insurance (Bauermeister, Meanley, Pingel, Soler, & Harper, 2013; Pérez-Figueroa et al., 2015). Further, this analysis hypothesizes that BMSM reporting current PrEP use would also report higher odds of all five HIV risk behaviors. Lastly, it has been hypothesized within this analysis that BMSM who report using PrEP would also report lower odds of PrEP use at each increasing level of syndemic variable count.

## 4.2 METHODS

### 4.2.1 Eligibility, Recruitment and Study Procedures

#### 4.2.1.1 Eligibility

A community-based sample of 5,858 MSM and transwomen participated in the Promoting Our Worth Equality and Resilience (POWER) cross-sectional survey over the four-year study period (2014-2017). For this subsample, men were included in the analysis if they were: 1) 18 years old or older; 2) reported anal sex with at least one male in the last 12 months; 3) did not identify as transgender; 4) identified as HIV-negative (at the time of the survey); 5) identified as Black and 6) reported HIV risk activity or reported currently using pre-exposure prophylaxis (PrEP). Due to the unique circumstances of transwomen, they were not included in this analysis but are the subject of separate analyses. The analytic sample for the current study is 1,411 BMSM.

#### 4.2.1.2 Recruitment

Participants were recruited at national Black Pride events in six cities across the country. Events were selected via a random digit lottery in order to use time-location sampling (TLS) for analysis

within city-specific studies as described previous literature (Karon & Wejnert, 2014; Kendall et al., 2008). Recruitment included indoor and outdoor events, as well as venues such as late night bars and nightclubs. Staff recruiters assessed each participant's ability to consent to the study.

#### 4.2.1.3 Study Procedures

The study used Windows-based tablets with the audio computer-assisted self-interviewer (ACASI) system. Each tablet provided a primary screener and documented consent from each participant. The study obtained a waiver of written consent from the local university's institutional review board in order to obtain anonymous results. The 25-minute survey assessed demographic variables, sexual risk, and psychosocial variable results (e.g. depression). Participants were compensated $10 for their participation.

### 4.2.2 Measures

#### 4.2.2.1 Outcome Variable

##### *Current PrEP Use*

Participants were asked to self-report if they were currently taking Truvada® to prevent HIV infection. Responses were recoded dichotomously (0= not currently taking PrEP, 1= currently taking PrEP). Any responses recorded as "Don't know" or "Refuse to answer" were recoded as missing. There was a total of 20 cases with missing information.

#### 4.2.2.2 HIV Behavioral Risk Variables

The behavioral risk variables were developed to closely adhere to the CDC guidelines of HIV risk and recommendation for PrEP use (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 2012, 2014b). If BMSM reported that they were at greater HIV in any of the following five categories, they were included in the analysis.

##### *HIV-Positive Partner*

This variable was comprised of three questions from the HIV risk section of the survey. Participants were asked *"Of the times you had receptive anal intercourse sex (bottomed) in the past 12-months, did you have condomless sex with anyone who told you they were HIV positive?"* with dichotomous responses (no = 0, yes = 1) with "don't know" and "refused to answer" recoded as missing. Participants were similarly queried about condomless sex as an insertive partner with men who disclosed being HIV positive. Lastly, participants were asked about the serostatus of their last sexual partner, which was recoded dichotomously (0 = HIV negative, unknown or not discussed; 1 = HIV positive). Participants were considered to be at risk if they answered any of the three questions affirmatively.

##### *Recent Sexually Transmitted Infections (STI)*

Participants were asked if they had been diagnosed with gonorrhea, chlamydia, syphilis or any other sexually transmitted infection other than HIV in the previous 12 months. Answers to queries about each infection were dichotomous and responses of "Don't know" and "Refused to answer" were recoded as missing. Participants were considered to be at greater risk for HIV if they had experienced any STI in the last 12 months.

### *Number of Sexual Partners*

While there is consensus that multiple sexual partners contribute to HIV risk, the number of partners that exhibit excess risk varies across studies. In the studies reviewed for this research, the lower threshold of HIV risk was three or more partners, which coincided with the median of the responses received (Koblin et al., 2006; Mustanski, Garofalo, Herrick, & Donenberg, 2007; Simon Rosser et al., 2008). Participants were considered to be at increased risk if they reported three or more sexual partners in the previous 12 months (0 = lower risk, 1 = greater risk).

### *History of Inconsistent Condom Use*

Participants were asked about condom use during anal intercourse. Participants were asked: *"Of the times you had receptive anal sex (bottomed), what proportion of the time did your partner wear a condom?"* with responses ranging from "Never" (0) to "Always" (4). Reponses of "Don't' know" or "Refused to answer" were recoded as missing. Participants were also asked about their experiences using condoms while being an insertive partner in the previous 12 months. All responses were recoded into lower risk (0 = always or most of the time use of condoms) and higher risk (1 = about half of the time or less use of condoms).

### *Sex Work*

Participants were asked a series of six questions, detailing any past year sex work with either/both men and women, if the participant had received "money, drugs or other goods" in exchange for sex by either gender, or if the participant had given "money, drugs or other goods" for sex. Each question was coded dichotomously with "Don't know" and "Refuse to answer" recoded as missing. A single dichotomous variable was created describing participants with any

sex work, regardless of gender or giving/receiving money, drugs or other goods = 1 and those with no sex work = 0.

#### 4.2.2.3 Syndemic Variables

A total of four variables were considered to contribute to a syndemic analysis. For each variable, questions contributing to a possible syndemic were recoded as necessary. The variables focused on individual-level factors associated with HIV risk and outcomes as described in previous literature (Tsai & Burns, 2015).

##### *Poly Substance Use*

Substance use was captured using a two-step process. First, a single question determined if participants have used any recreational substances in the past year: "*In the past 12 months, have you used recreational drugs?*" with dichotomous responses (yes, no) in addition to "Don't know" and "Refuse to answer" which were recoded as missing. Second, poly substance use was defined as the use of three or more substances as in previous literature within the past three months (Mimiaga et al., 2015; Stall et al., 2003). Substance included in the measure were: cocaine, crack, heroin, opiates, methamphetamine, inhalants (e.g. "poppers") and other party drugs. The use of marijuana was not included in analysis. Each question asked if the participants had used these substances in the past three months. Results were recoded to dichotomous responses (yes, no). The summation of the number of substances used were recoded into poly substance use as three or more (yes) or less than three substances (no).

### *Depression*

Depression was assessed using the CESD-10 which screens for past-week depressive symptoms. Composed of 10 questions, the scores, including three questions that are reverse-coded, were summed. A total score of 10 or more of a possible 30 was used to indicate the likelihood of moderate to severe depression as previously demonstrated in literature (Andresen et al., 1994).

### *Intimate Partner Violence*

Intimate partner violence (IPV) was assessed using a single question: "*In the past year, have you been in a relationship with a partner who has ever hit, kicked, slapped, beaten or in any other way physically assaulted you?*" Dichotomous (yes, no) responses were provided in addition to "don't know" and "Refuse to answer." Answers "Don't know" and "refused to answer" were recoded as missing.

### *Problematic Drinking*

Binge drinking, defined as five or more drinks in one sitting, was measured by a single question in this analysis: *"In the past 12 months, how often did you have 5 or more alcoholic drinks in one sitting?"* Time responses were provided on a scale from "never" to "more than once a day." Binge drinking was recoded as a dichotomous (yes, no) variable to determine if the participant was considered to have problematic drinking (more than one binge drinking episode per month) as seen in previous literature (Jie et al., 2012; Wong et al., 2008).

### 4.2.3 Analytic Procedure

All analyses were completed using Stata 14.2 (Stata Corp, College Station, TX) in the following steps. First, listwise deletion was used for missing information including 20 participants who did not have complete information for outcome variables. After demographic comparisons of variance, bivariate logistic analyses were conducted in order to determine the relationship of each of the demographic, HIV behavioral risk and syndemic variables with the dependent variable (current use of PrEP) as seen in Table 4-2. Third, a stepwise logistic regression with the number of syndemic variable counts, controlling for demographic variables, is seen in Table 4-3 to understand if there is an additive interplay of syndemic variables that contributed to differences in testing within the previous six months. As detailed in chapter 3, the Table 4-4 displays measures of joint effects/synergy between syndemic variables referring to BMSM not reporting current PrEP use.

## 4.3 RESULTS

Demographic comparisons of the sample are presented in Table 4-1. There were significant differences among those on PrEP and those not using PrEP based on education ($p<.001$) and relationship status ($p<.001$), but no other demographic differences were observed. Among HIV risk variables, there was significant variation among PrEP users and non-users based on reports of an HIV-positive partner in the last 12 months ($p<.001$), last year STI ($p<.001$) and past year sex work ($p<.001$). No significant differences were found based on number of sexual partners, or history of inconsistent condom use. There were also significant differences found among three

of the four syndemic variables in analysis: previous 3-month poly drug use (p<.001), past year intimate partner violence (p<.001) and problematic binge drinking (p<.001) with no significant difference by depression.

In bivariate analyses, found in Table 4-2, college-educated BMSM (OR = 0.45, 95% CI: 0.33, 0.61) and BMSM with graduate education (OR = 0.59, 95% CI: 0.40, 0.89) had significantly less odds than high school-educated or less BMSM to report using PrEP. Additionally, BMSM on PrEP had higher odds of reporting being on in a relationship (OR = 1.80, 95% CI: 1.35, 2.40).

In bivariate analyses of HIV risk variables, PrEP-using BMSM had more odds of reporting an HIV-positive partner (OR = 2.76, 95% CI: 2.06, 3.72), reporting diagnosis of past-year STI (OR = 2.93, 95% CI: 2.22, 3.86) and reporting past year sex work (OR = 2.34, 95% CI: 1.51, 3.62). Among syndemic variables, BMSM using PrEP had significantly greater odds of previous 3-month poly drug use (OR = 7.86, 95% CI: 4.28, 14.41), past year intimate partner violence (OR = 4.10, 95% CI: 3.05, 5.52) and problematic binge drinking (OR = 2.01 95% CI: 1.54, 2.62).

A standard stepwise multivariable logistic regression was computed to understand the impact of syndemic variable counts. Model 1 contains a simultaneous regression of demographic variables. College educated (AOR = 0.39, 95% CI: 0.28, 0.55) and graduate-degree educated (AOR = 0.50, 95% CI: 0.32, 0.79) had less odds of being on PrEP and those in a relationship (AOR = 1.89, 95% CI: 1.40, 2.54) had significantly higher odds of reporting PrEP use. Model 2 shows the effect sizes for syndemic variable counts, where BMSM on PrEP were significantly more likely to report PrEP use at increasing variable count compared to men who reported no issues. Model 3 demonstrates that despite a syndemic, this minority of BMSM is significantly

more likely to be on PrEP as the number of syndemic variables increase, such that 3 issues (AOR = 5.65, 95% CI: 3.17, 10.08) and 4 issues (AOR = 18.34, 95% CI: 5.01, 67.20) increase substantially.

Table 4-4 displays the results of the tests of joint effects resulting in RERI, AP and S. In order to aid in the understanding of these data, the outcomes variable, (PrEP use) was reverse coded (0=yes, 1=no); however, the number of participants in were unequal and therefore did not provide consistent results. In order to verify synergistic effects between variables, PrEP use was analyzed for joint effects with the syndemic variables from Table 4-3. All RERI and AP with greater than zero were considered to have a greater than additive effect, while a negative value for RERI or AP indicates less than additivity (Knol et al., 2011). There were synergistic effects between all of the syndemic variables for BMSM who were on PrEP: poly drug use and depression (AP = 0.68, S = 3.92), poly drug use and intimate partner violence (AP = 0.64, S = 3.10), depression and intimate partner violence (AP = 0.02, S = 1.02), intimate partner violence and problematic binge drinking (AP = 0.52, S = 2.52), problematic binge drinking and polydrug use (AP = 0.62, S=2.98) and problematic binge drinking and depression (AP = 0.01, S = 1.02). These measures verify that there is synergy between these variables and that a syndemics is present.

**Table 4-1 Demographic Variable Comparison for Participants with HIV Risk and PrEP Using BMSM in POWER 2014-2017 (N=1,411)**

| Demographic Variable | HIV Risk, No PrEP (n = 1,107) | PrEP Use (n = 284) | $X^2$ Variance |
|---|---|---|---|
| Age | | | 0.39, p=0.824 |
| 18-29 | 723 (65.3) | 180 (63.4) | |
| 30 – 39 | 267 (24.1) | 73 (25.7) | |
| 40+ | 117 (10.6) | 31 (10.9) | |
| Sexuality | | | 0.71, p=0.871 |
| Gay/Homosexual | 907 (81.9) | 228 (80.6) | |
| Heterosexual | 6 (0.5) | 1 (0.4) | |
| Bisexual | 176 (15.9) | 50(17.7) | |
| Other | 18 (1.6) | 4 (1.4) | |
| Annual Income | | | 0.02, p=0.901 |
| $0-29,999 | 416 (38.0) | 106 (37.6) | |
| $30,000+ | 679 (62.0) | 176 (62.4) | |
| Education | | | 26.93, p<.001* |
| High school or less | 207 (18.7) | 92 (32.4) | |
| Some college or college | 721 (65.2) | 145 (51.1) | |
| Post Bac/Graduate | 178 (16.1) | 47 (16.6) | |
| Relationship status | | | 16.49, p<.001* |
| Single | 846 (77.8) | 183 (66.1) | |
| Partnered | 241 (22.2) | 94 (33.9) | |
| Current Insurance | | | 0.74, p=0.391 |
| No | 154 (13.9) | 34 (12.0) | |
| Yes | 952 (86.1) | 250 (88.3) | |
| HIV Risk Variables (all last 12 months) | | | |
| HIV-Positive Sexual Partner | | | 47.14, p<.001* |
| No | 657 (75.3) | 126 (52.5) | |
| Yes | 215 (24.7) | 114 (47.5) | |
| Last year STI | | | 61.77, p<.001* |
| No | 872 (78.9) | 159 (56.0) | |
| Yes | 234 (21.1) | 125 (44.0) | |
| Three or more sexual partners | | | 0.04, p=0.842 |
| No | 344 (31.1) | 90 (31.7) | |
| Yes | 763 (68.9) | 194 (68.3) | |
| History of Inconsistent Condom Use for anal sex | | | 0.56, p=0.452 |
| Always, most of the time | 567 (51.3) | 138 (48.8) | |
| Half of the time or less | 539 (48.7) | 145 (51.2) | |
| Sex Work | | | 15.37, p<.001* |
| No | 1041 (94.3) | 247 (87.6) | |
| Yes | 63 (5.7) | 35 (12.4) | |
| Syndemic Variables | | | |
| 3-month Poly Drug Use | | | |
| No (0) | 1090 (98.5) | 253 (89.1) | 59.68, p<.001* |
| Yes (1) | 17 (1.5) | 31 (10.9) | |
| Depression (CESD-10) | | | |
| No (0) | 667 (60.3) | 175 (61.6) | 0.18, p=0.674 |
| Yes (1) | 440 (39.8) | 109 (38.4) | |
| Intimate Partner Violence | | | |
| No (0) | 962 (87.0) | 176 (62.0) | 95.22, p<.001* |
| Yes (1) | 144 (13.0) | 108 (38.0) | |
| Problematic Drinking | | | |
| No (0) | 756 (68.4) | 147 (51.8) | 27.34, p<.001* |
| Yes (1) | 350 (31.7) | 137 (48.2) | |

Note: column percentages used within categories, *p≤.05

**Table 4-2 Bivariate Analysis of Demographic, HIV Behavioral Risk and Syndemic Variables of BMSM PrEP users and Non-PrEP users in POWER 2014-2017 (N = 1,411)**

| | Non-PrEP Users (n = 1,107) | | PrEP Users (n = 284) | |
|---|---|---|---|---|
| Demographic Variable | OR | 95% CI | OR | 95% CI |
| Age | | | | |
| 18-29 | 1.06 | 0.69 – 1.63 | 0.93 | 0.61 – 1.44 |
| 30 – 39 | 0.97 | 0.60 – 1.56 | 1.03 | 0.64 – 1.66 |
| 40+ (ref) | 1.0 | | 1.0 | |
| Sexuality | | | | |
| Gay/Homosexual (ref) | 1.0 | | 1.0 | |
| Heterosexual | 1.51 | 0.18 – 12.59 | 0.66 | 0.08 – 5.53 |
| Bisexual | 0.88 | 0.63 – 1.25 | 1.13 | 0.80 – 1.60 |
| Other | | | 0.88 | 0.29 – 2.64 |
| Annual Income | | | | |
| $0-29,999 (ref) | 1.0 | | 1.0 | |
| $30,000+ | 0.98 | 0.75 – 1.29 | 1.02 | 0.77 – 1.33 |
| Education | | | | |
| High school or less (ref) | 1.0 | | 1.0 | |
| Some college or college | 2.21* | 1.63 – 2.99 | 0.45* | 0.33 – 0.61 |
| Post Bac/Graduate | 1.68* | 1.12 – 2.52 | 0.59* | 0.40 – 0.89 |
| Relationship status | | | | |
| Single | 1.0 | | 1.0 | |
| Partnered | 0.55 | 0.42 – 0.74 | 1.80* | 1.35 – 2.40 |
| Current Insurance | | | | |
| No | 1.0 | | 1.0 | |
| Yes | 0.84 | 0.57 – 1.25 | 1.18 | 0.80 – 1.77 |
| HIV Risk Variables (all last 12 months) | | | | |
| HIV-Positive Sexual Partner | | | | |
| No (0) (ref) | 1.0 | | 1.0 | |
| Yes (1) | 0.36* | 0.27 – 0.49 | 2.76* | 2.06 – 3.72 |
| Bacterial STI | | | | |
| No (0) (ref) | 1.0 | | 1.0 | |
| Yes (1) | 0.34 | 0.26 – 0.45 | 2.93* | 2.22 – 3.86 |
| Number of sexual partners | | | | |
| X ≤ 3 (0) (ref) | 1.0 | | 1.0 | |
| X > 3 (1) | 1.03 | 0.78 – 1.36 | 0.97 | 0.73 – 1.28 |
| History of Inconsistent condom use for anal sex | | | | |
| Always, most of the time (0) (ref) | 1.0 | | 1.0 | |
| Half of the time or less (1) | 0.90 | 0.70 – 1.17 | 1.12 | 0.85 – 1.44 |
| Sex Work | | | | |
| No (0) (ref) | 1.0 | | 1.0 | |
| Yes (1) | 0.43* | 0.28 – 0.66 | 2.34* | 1.51-3.62 |
| Syndemic Variables | | | | |
| 3-month Poly Drug Use | | | | |
| No (ref) | 1.0 | | 1.0 | |
| Yes | 0.13* | 0.07 – 0.23 | 7.86* | 4.28 – 14.41 |
| Depression (CESD-10) | | | | |
| No (ref) | 1.0 | | 1.0 | |
| Yes | 1.06 | 0.81 – 1.38 | 0.94 | 0.72 – 1.23 |
| Intimate Partner Violence | | | | |
| No (ref) | 1.0 | | 1.0 | |
| Yes | 0.24* | 0.18 – 0.33 | 4.10* | 3.05 – 5.52 |
| Problematic Drinking | | | | |
| No (ref) | 1.0 | | 1.0 | |
| Yes | 0.50* | 0.38 – 0.65 | 2.01* | 1.54 – 2.62 |

OR = odds ratio, CI = confidence interval, *≤.05

**Table 4-3 Logistic Regression Analysis of PrEP Use with Demographic and Syndemic Variables of BMSM in POWER 2014-2017 (N = 284)**

| Model | Adjusted Odds Ratio | 95% Confidence Interval |
|---|---|---|
| Model 1 (demographic variables) | | |
| Age | | |
| 18-29 | 0.95 | 0.61 – 1.49 |
| 30 – 39 | 1.06 | 0.65 – 1.73 |
| 40+ | 1.0 | |
| Sexuality | | |
| Gay/Homosexual | 1.0 | |
| Heterosexual | 0.61 | 0.07 – 5.26 |
| Bisexual | 1.10 | 0.77 – 1.59 |
| Other | 1.01 | 0.32 – 3.17 |
| Annual Income | | |
| $0-29,999 | 1.0 | |
| $30,000+ | 1.15 | 0.83 – 1.59 |
| Education | | |
| High school or less | 1.0 | |
| Some college or college | 0.39* | 0.28 – 0.55 |
| Post Bac/Graduate | 0.50* | 0.32 – 0.79 |
| Relationship status | | |
| Single | 1.0 | |
| Partnered | 1.89* | 1.40 – 2.54 |
| Current Insurance | | |
| No | 1.0 | |
| Yes | 1.36 | 0.88 – 2.11 |
| | | |
| Model 2 (Count Variable) | | |
| Syndemic = 0 (ref) | 1.0 | |
| Syndemic = 1 | 1.51* | 1.07 – 2.13 |
| Syndemic = 2 | 1.69* | 1.11 – 2.57 |
| Syndemic = 3 | 7.26* | 3.91 – 13.49 |
| Syndemic = 4 | 23.48* | 6.29 – 87.66 |
| | | |
| Model 3 | | |
| Syndemic = 0-1 (ref) | 1.0 | |
| Syndemic = 2 | 1.32 | 0.93 – 1.90 |
| Syndemic = 3 | 5.65* | 3.17 – 10.08 |
| Syndemic = 4 | 18.34* | 5.01 – 67.20 |

*$p \leq .05$

**Table 4-4 Analysis of Joint Effects/Synergy of Syndemic Variables in BMSM using PrEP in the POWER Study (N = 284)**

| | | Odds Ratio | | RERI | AP | S |
|---|---|---|---|---|---|---|
| | | Expected | Observed | | | |
| **Poly drug use** | **Depression** | **3.79** | **11.95** | **8.15** | **0.68** | **3.92** |
| **Poly drug Use** | **Intimate Partner Violence** | **5.58** | **16.13** | **10.25** | **0.64** | **3.10** |
| **Depression** | **Intimate Partner Violence** | **3.60** | **3.66** | **0.06** | **0.02** | **1.02** |
| **Intimate Partner Violence** | **Problematic Drinking** | **3.58** | **7.51** | **3.93** | **0.52** | **2.52** |
| **Depression** | **Problematic Drinking** | **5.45** | **14.27** | **8.81** | **0.62** | **2.98** |
| **Poly drug use** | **Problematic Drinking** | **1.88** | **1.89** | **0.02** | **0.01** | **1.02** |

## 4.4 DISCUSSION

This study is one of the first to specifically study the differences among BMSM using and not using PrEP in non-clinical settings. In tests of variance and bivariate testing, there were no significant differences in current insurance coverage among BMSM using and those not using PrEP. This finding fails to support the hypothesis that insurance coverage may have an impact on PrEP use and suggests that lack of current insurance coverage may not be a significant barrier to PrEP use among BMSM as some literature has indicated (Bauermeister et al., 2013; Pérez-Figueroa et al., 2015).

Aside from insurance, bivariate analyses demonstrated that BMSM reporting current PrEP use had significantly higher odds of reporting an HIV-positive sexual partner, past-year STI and past year sex work. While BMSM using PrEP did not have significantly higher estimates for all five risk behaviors as hypothesized, these men did have significantly higher estimates for three of the five risk behaviors. This may indicate that among BMSM that exhibit HIV risk, providers are successfully engaging men with the highest HIV risk into PrEP regimens.

Similar results were found within syndemic variables in that BMSM on PrEP had higher odds of reporting past three-month poly drug use, past-year intimate partner violence and problematic binge drinking. Again, while a minority of men in the sample, BMSM using PrEP did have higher risk than the larger comparison group.

In the multivariable analysis, a minority of BMSM were more likely to be on PrEP at each level of increasing syndemic count. These data did not support the hypothesis that BMSM using PrEP would report less PrEP use as syndemic variable counts increased. This suggests that perhaps BMSM at the greatest risk have been successfully engaged in PrEP, and that PrEP efforts may have been less robust among men with comparatively less HIV risk.

Analyses of the joint effects and synergy seeking greater than additivity found that although depression was not significant in bivariate analyses, it had a synergistic effect with poly drug use and problematic binge drinking when reported among those using PrEP in addition to variables which had been significant in bivariate analysis. Furthermore, there was a synergistic effect between depression and intimate partner violence, which may indicate a renewed need to address depression among this population.

Despite best efforts, there are limitations to this analysis. Data for this analysis, particularly the outcome variable, were provided by self-report and subject to recall bias. While the number of BMSM reporting PrEP use was much smaller than the comparison group resulting in limited power and large confidence intervals, the number of PrEP users in this analysis mirror other studies suggesting slow uptake of PrEP among BMSM. In addition, PrEP-based risk indications for inclusion criteria were used in this analysis for risk comparisons to uncover challenges among BMSM. Several of the syndemic variables were defined by a single question and it is possible that a single item was not exhaustive or provided a complete picture the lives of

BMSM, however, whenever possible the survey instrumentation used validated measures and scales. Depression was measured using a validated scale; however, due to the nature of depression, it is possible that those most depressed may have been less likely to attend social events where data were collected. It is also possible that the results of the study may be subject to social desirability. The generalizability of the sample may be limited, although national data collection increases confidence in these data and interpretation of results. Lastly, self-reports of PrEP use are an important step in understanding non-clinical samples of BMSM in community settings, however, there was no objective biological measure of adherence. As adherence to the PrEP medication is essential for the reduction of HIV transmission, a methodological improvement for the next step should include a biological measure of adherence. Additionally, some of the behaviors that have been reported by BMSM using PrEP have been associated with non-adherence among MSM living with HIV(Chesney et al., 2000). This biological confirmation will assist in the determination of future needs, such as adherence interventions.

This analysis is helpful in understanding the underlying differences among BMSM currently at risk for HIV. BMSM reporting PrEP use in this sample appear to be those most at risk for HIV, providing a positive start, but greater PrEP uptake will be necessary to make large –scale changes in the incidence of HIV among BMSM. While there does not appear to be a difference in reports of depression between those using and those not using PrEP, when another syndemic variable co-occurs with depression, there appears to be synergy among BMSM using PrEP. Given this information, developing an intervention to support BMSM experiencing depression may be one method of introducing PrEP to a wider audience – expanding PrEP practitioners to those providing mental health services may be one way to better secure PrEP uptake. Perhaps another method of engaging mental health providers and BMSM could be the

co-location of services, which has been suggested previously (Smith et al., 2012). Lastly, this analysis suggests that while practitioners may be correctly focusing on those considered most at risk, additional strategies will be required to more than stall increases in HIV incidence and prevalence among this critical group.

# 5.0 UNDERSTANDING THE IMPACT OF SYNDEMICS ON HIV CARE CONTINUUM OUTCOMES AMONG SEROPOSITIVE BLACK MEN WHO HAVE SEX WITH MEN IN THE POWER STUDY

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## 5.1 INTRODUCTION

Men who have sex with men (MSM) in the United States continue to be the most impacted group in terms of HIV incidence and prevalence. Current models from the Centers for Disease Control and Prevention (CDC) estimate that one in every two Black men who have sex with men (BMSM) will seroconvert with HIV in their lifetime compared to one in every eleven White MSM (U.S. Department of Health and Human Services. Centers for Disease Control and Prevention, 2014a). Extant literature has previously theorized that this disparity in HIV incidence is related to late/latent testing among BMSM, higher background sexually transmitted infections (STI), attrition from HIV care, and an unrecognized early epidemic among BMSM (Millett et al., 2007; Millett et al., 2012). Even with the identification of these challenges, the disparity among MSM has persisted indicating the need for increased research among BMSM.

In 2010, the Obama Administration released the first National HIV/AIDS strategy from the Office of National HIV/AIDS Policy (Millett et al., 2010; White House Office of National HIV/AIDS Policy, 2017). The strategy used currently available science and metrics to galvanize government agencies, researchers and practitioners to address the domestic HIV epidemic using 10 indicators, including: increasing the number of individuals who are aware of their HIV infection to at least 90 percent; increasing the number of newly diagnosed individuals linked to care to at least 85 percent; and increasing the number of people who have an HIV diagnosis and are virally suppressed to 80 percent (White House Office of National HIV/AIDS Policy, 2017). The national strategy and therefore the HIV care continuum contain outcome targets for effectiveness (Sullivan et al., 2012a). National HIV/AIDS Strategy targets can been seen in Figure 5-1.

Data published in 2010 reviewed HIV care outcomes to understand opportunities for improvements in HIV treatment. At the time, one review reported that an estimated 21 percent of the US population living with HIV was undiagnosed (Campsmith, Rhodes, Hall, & Green, 2010). Among new diagnoses, between 35 and 40 percent of individuals were identified with AIDS within one year of HIV diagnosis due in part to late diagnoses (Campsmith et al., 2010). Beyond diagnosis, active referrals and linkage to timely medical care for HIV infection were not standard (E. M. Gardner et al., 2011). Gardner and colleagues estimated that only 75 percent of individuals diagnosed with HIV began medical care for HIV within the first year after diagnosis (E. M. Gardner et al., 2011). Even when in care, guidelines for beginning antiretroviral therapy (ART) varied considerably based on indicators of virus progression (Hull et al., 2012). Of the individuals living with HIV, Gardner and colleagues found that only 25 percent had initiated ART and that only 19 percent were virally suppressed, limiting the ability to transmit the virus

(E. M. Gardner et al., 2011). The research resulted in graphical representations of estimates within each stage of the HIV care continuum, which have been used by municipalities, government agencies and researchers to track progress on each outcome (Valdiserri, 2012).

The current gold standard for linkage to HIV medical care is a medical visit within three months of diagnosis as established by the Department of Health and Human Services (DHHS), National Academy of Medicine and the national HIV/AIDS strategy (Mugavero et al., 2013). A 2012 systematic review reported that linkage to medical care was an essential facet of navigating individuals with HIV through care and into the initiation of ART (Thompson et al., 2012).There are states and cities that have chosen shorter linkage targets and consensus has not been reached on the optimum linkage period for subpopulations (Mugavero et al., 2013). The HIV strategy for 2020 is encouraging a shift to linkage of HIV medical care within one month after diagnosis (White House Office of National HIV/AIDS Policy, 2017).

Biomedical advances in the treatment of HIV have contributed to increases in the life expectancy and quality of life for individuals living with HIV, although these gains have not been uniform across race and transmission category (Samji et al., 2013). Biological testing to measure the number of copies of HIV in a milliliter of blood is used during HIV care as one measure of viral progression, known as a viral load (Feinberg, 1998; Gross, Bilker, Friedman, & Strom, 2001). The use of antiretroviral therapy suppresses the replication of the HIV virus, reducing the measurable viral load (VL) when there is adherence to ART. Achievement of an undetectable viral load is the goal of HIV treatment for two reasons: the health of those living with HIV and the decreased ability to transmit the virus to others (Gross et al., 2001). Tests vary in being able to define this term, often seen as a level of virus below the threshold of detection, ranging between 20 and 75 copies/ml (Buchacz et al., 2004). In 2014, researchers in the

PARTNERS study of serodiscordant couples where the seropositive partner had an undetectable viral load, reported no new HIV infections during the first two years of the study and estimated that the chance of HIV transmission between partners was four percent or less (Rodger et al., 2014). Achieving undetectable viral load is essential to addressing disparities in HIV transmission and thus reduce the community viral load (Hull et al., 2012).

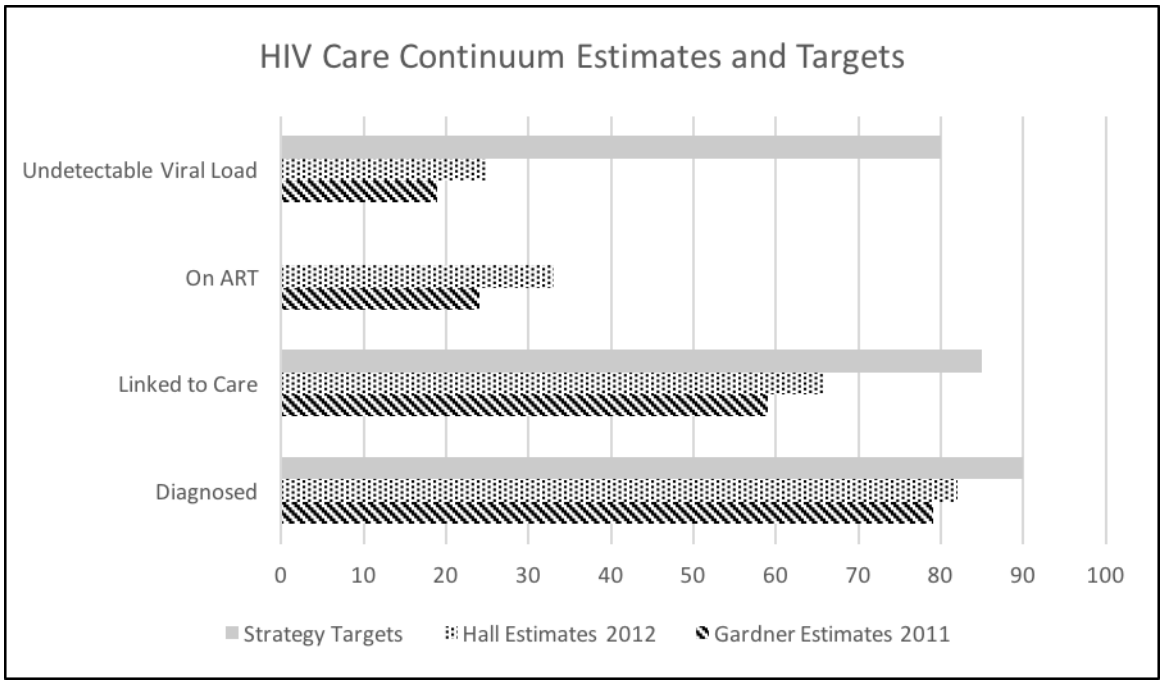


**Figure 5-1 HIV Care Continuum Estimates and National HIV/AIDS Strategy Targets for the United States, All Populations.**

Note: Data presented from Gardner et al. (2011), Centers for Disease Control and Prevention (2013), Mugavero et al. (2013) and the White House Office of National HIV/AIDS Policy (2017). ART = Antiretroviral Therapy; there is currently no specific target for ART prescription in the national strategy.

As there continue to be disparities between black and white MSM at each step of the HIV cascade of care, reviewing studies of the continuum variables stratified by race and ethnicity has been suggested (Rosenberg et al., 2014). Given the importance of navigating the care continuum to preserving the health of those with HIV and limiting transmission of HIV, an understanding of

factors that impact engagement along the continuum in BMSM is paramount to improving outcomes.

The theory of syndemic production offers one way to explore the effect of co-occurring epidemics among BMSM. Syndemic theory describes the co-occurrence of epidemics among a particular group that synergistically combine to exacerbate poor health outcomes (Halkitis et al., 2012; Singer, 1994; Stall et al., 2003). Syndemic research has primarily focused on HIV risk activity or HIV seroconversion among urban MSM (Tsai & Burns, 2015). The most often used method for modeling a syndemic has been the use of regression estimates at increasing counts of psychosocial issues, most often including mental health, substance use and violence variables (Tsai & Burns, 2015).

At least one repeated measures mixed model study of MSM in the Multicenter AIDS Cohort Study (MACS) found that syndemics count was associated with a detectable viral load, and although the study did not find an association between ART adherence and syndemic variable counts, non-whites in the study reported less adherence (Friedman et al., 2015). The goal of the HIV care continuum is to ensure that individuals living with HIV are virally suppressed, and therefore do not progress to AIDS or AIDS-complications, which could be life-threatening and increase transmission. Therefore, an analysis of the Promoting Our Worth, Equality and Resilience (POWER) NIH-sponsored study of BMSM and transgender women has been used to model any impact the presence of syndemic has on the engagement of BMSM in the continuum of care. Drawing from extant literature, the hypothesis of this analysis is that BMSM at each increasing count of syndemic variables display significantly less odds of being currently in care for HIV or using ART. It has also been hypothesized that reported linkage to care of three months or less will be associated with undetectable viral load.

## 5.2 METHODS

### 5.2.1 Eligibility and Recruitment

#### 5.2.1.1 Eligibility

A community-based sample of 5,858 MSM and transwomen participated in the cross-sectional survey over the four-year study period (2014-2017). For this subsample, men were included in the analysis if they were: 1) 18 years old or older; 2) had anal sex with at least one male in the last 12 months; 3) did not identify as transgender; 4) identified as HIV-positive (at the time of the survey); and 5) identified as Black. Due to the unique circumstances of transwomen, they were not included in this analysis but are the subject of separate analyses. The analytic sample for the current analysis is 925 BMSM.

#### 5.2.1.2 Recruitment

Participants were recruited at national Black Pride events in six cities across the country. Events were selected via a random digit lottery in order to use time-location sampling (TLS) for analysis within city-specific studies as described previous literature (Karon & Wejnert, 2014; Kendall et al., 2008). Recruitment included indoor and outdoor events, as well as venues such as late night bars and nightclubs. Staff recruiters assessed each participant's ability to consent to the study.

#### 5.2.1.3 Study Procedures

The study used Windows-based tablets with the audio computer-assisted self-interviewer (ACASI) system. The tablets provided a primary screener and recorded consent from each participant. The researchers of this study obtained a waiver of written consent from the local

university's institutional review board in order to obtain anonymous results. The 25-minute survey assessed demographic variables, sexual risk, and psychosocial variable results (e.g. depression). Participants were compensated $10 for their participation.

### 5.2.2 Measures

#### 5.2.2.1 Outcome Measures

##### *Currently in Care*

Participants were asked to self-report if they had been in care for HIV within the past year. Responses were recoded dichotomously (0= not in HIV care in last 12 months, 1= used HIV care in the last 12 months). Any responses recorded as "Don't know" or "Refuse to answer" were recoded as missing. There was a total of 42 cases with missing information.

##### *Using Antiretroviral Therapy*

Participants were asked to self-report if they had used antiretroviral therapy within the past year. Responses were recoded dichotomously (0= not currently using ART, 1= currently using ART). Any responses recorded as "Don't know" or "Refuse to answer" were recoded as missing. No missing cases were found.

##### *Viral Load*

Participants were asked to self-report an estimate of their viral load from their most recent encounter with a healthcare provider. Responses were recoded dichotomously (0= detectable viral load, 1= undetectable viral load). Any responses recorded as "Don't know" or "Refuse to answer" were recoded as missing. There was a total of 92 cases missing.

#### 5.2.2.2 Demographic Variables

Participants reported their age category, income, sexual orientation (sexuality), and employment status as seen in Table 1. There were three age categories for adults: YMSM 18-29 (0) and MSM 30-39 (1) and MSM 40 and over (2). Income was reported dichotomously below and up to the median (0) and above the median (1). Sexual orientation was collected in four categories which included: "gay/same gender loving" (0), "heterosexual or 'straight'" (1), "bisexual" (2) and "other" (3). Insurance coverage was asked by a single question in this analysis: "*Do you currently have health insurance or health care coverage?"* Dichotomous (yes, no) responses were recorded in addition to "Don't know" and "Refuse to answer" which were recoded as missing. All other variables used for analysis are included in Table 5-1 for reference.

#### 5.2.2.3 Syndemic Variables

A total of five variables were considered to contribute to a syndemic for analysis. For each variable, questions were isolated relating to the psychosocial issue contributing to a possible syndemic and recoded as necessary. The variables included focus on individual-level factors of sexual risk and HIV outcomes as described in previous literature (Tsai & Burns, 2015).

##### *Poly Substance Use*

Substance use was captured in this study using a two-step process. First, by a single question determined if participants have used any recreational substances in the past year: "*In the past 12 months, have you used recreational drugs?*" with dichotomous responses (yes, no) in addition to "don't know" and "refuse to answer." Answers "don't know" and "refused to answer" were recoded as missing. Second, poly substance use was defined as the use of three or more substances as in previous literature (Mimiaga et al., 2015; Stall et al., 2003). Substances

included in the measure were: cocaine, crack, heroin, opiates, crystal meth, inhalants (e.g. "poppers") and other party drugs. The use of marijuana was not included in analysis. Each question asked if the participants had used these substances in the past three months. Results were recoded to dichotomous responses (yes, no). The summation of the number of substances used were recoded into poly substance use as three or more (yes) or less than three substances (no).

### *Depression*

Depression was assessed using the CESD-10, which screens for past-week depressive symptoms. The CESD-10 is comprised of 10 questions, including three questions which are reverse-coded, which were summed. A total score of 10 or more of a possible 30 was used to indicate likelihood of moderate to severe depression as previously demonstrated in literature (Andresen et al., 1994).

### *Intimate Partner Violence*

IPV was assessed using a single question: "*In the past year, have you been in a relationship with a partner who has ever hit, kicked, slapped, beaten or in any other way physically assaulted you?*" Dichotomous (yes, no) responses were provided in addition to "Don't know" and "Refuse to answer" which were recoded as missing.

### *Problematic Drinking*

Binge drinking, defined as five or more drinks in one sitting, was measured by a single question in this analysis: "*In the past 12 months, how often did you have 5 or more alcoholic drinks in one sitting?"* Time responses were provided on a scale from "never" to "more than once a day." Binge drinking was used as a dichotomous (yes, no) variable to determine if the

participant was considered to have problematic drinking (more than one binge drinking episode per month) as seen in previous literature (Jie et al., 2012; Wong et al., 2008).

### *Sexual Risk*

A total of 15 questions were used to develop this dichotomous risk variable (0 = less to no risk of transmission, 1 = greater risk of transmission) based on: substance use during last sexual encounter, recent bacterial sexually transmitted infection (STI), history of condom use, number of sexual partners and history of sex work (Millett et al., 2007; Van Kesteren, Hospers, & Kok, 2007). Two of these criteria, recent bacterial STI and participation in sex work, were recorded dichotomously in the survey (yes, no). The other three criteria were recoded to be dichotomous. To determine sexual risk related to substance use, a single question asked, "Before or during the last time you had sex with this partner [main or casual], did you use: alcohol, drugs, alcohol and drugs, neither alcohol nor drugs?" Participants could also select "Don't know" or "Refuse to answer." Answers were recoded dichotomously for any substance use before last sexual encounter (1) or no substance use (0). For number of sexual partners, the question *"In the past 12 months, with approximately how many different men have you had anal sex?"* was dichotomized at three partners or more as seen in previous literature. In order to determine BMSM who may be hypothesized to have "greater risk" (1) with more than three partners in the past 12 months, while men with three partners or less were considered "lower risk" (0). Lastly, participants were asked, *"Of the times you had <u>receptive</u> anal sex (<u>bottomed</u>), what proportion of the time did your partner wear a condom?"* and *"Of the times you had <u>insertive</u> anal sex (<u>topped</u>), what proportion of the time did you wear a condom?"* with responses ranging from "never" (0) to "always" (4). Participants who reported half of the time (2) or less were

considered to have more risk. A final dichotomous variable was created by responses of no on all questions, indicating low to no risk (0) or higher HIV risk (1).

#### 5.2.2.4 HIV Care Linkage Variable

In order to determine the impact of linkage on undetectable status, data related to linkage time were recoded based on the question: "*How soon after receiving your HIV diagnosis were you seen by a doctor, nurse, or other health care provider for a medical evaluation or care related to your HIV infection?"* Responses ranged from (0) within one week to (4) after at least one year. Responses were recoded to specify greater than three months (0) and less than or equal to three months (1) as benchmarks established in previous literature (Thompson et al., 2012).

### 5.2.3 Analytical Procedure

Simple frequencies were calculated in order to compile the HIV care continuum of BMSM. Participant responses were used to calculate the percentage of BMSM who were aware of their status, those who had been linked to care, retained in care, prescribed ART and those who reported suppressed viral load. Percentages of the total estimate of BMSM who were seropositive can be seen at the top of each bar in Figure 5-2. In addition to percentages of the total estimates of men living with HIV, percentages of the men who have progressed from one care continuum phase to the next phase is displayed within figure 5-2.

All analyses were completed using Stata 14.2 (Stata Corp, College Station, TX). Analysis of the research aims and hypotheses were achieved in the following steps. First, listwise deletion was used for missing information, but all missing information was less than ten percent of the sample. Second, demographic comparisons and tests of variance were computed as seen in

Table 5-1. Bivariate logistic analyses were also conducted in order to determine the relationship of demographic and syndemic variables with HIV care variables (self-report of being in care for HIV, using ART in past year) as seen in Table 5-2. Last, a stepwise logistic regression with the number of syndemic variable counts, controlling for demographic variables, is seen in Table 5-3 to understand if there is an additive interplay of syndemic problems that contributed to differences in HIV care outcomes in the last 12 months. Bivariate and logistic analyses were conducted to explore the relationship of demographic variables and time from diagnosis to linkage on HIV undetectable status as seen in Table 5-4.

## 5.3 RESULTS

Demographic comparisons of the sample are presented in Table 5-1. While there was not a significant difference in participants reporting being in care and those not in care based on age, there were significant differences in age for participants reporting use of antiretroviral therapy ($p<.001$) and reporting detectable viral loads ($p=.001$). There was a significant difference in income among participants who reported detectable and undetectable viral loads ($p=.019$). There were significant differences in reported education between participants who were and were not using antiretroviral therapy ($p=.036$). Current insurance coverage differed significantly across all care continuum outcomes: in care status ($p<.001$), ART use ($p<.001$) and detectable viral load ($p=.028$). There were no significant differences in sexual orientation or relationship status for any care continuum outcome.

Among independent variables, there was only a significant difference in linkage for participants using ART ($p<.001$). Within syndemic variables present in Table 5-1, there were

significant differences in past three-month poly-drug use (p<.001), depression (p<.001) and intimate partner violence (p=.002) based on viral load.

Table 5-2 displays bivariate analyses for demographic and syndemic variables based on care status and ART use. Participants without insurance coverage were significantly less likely to be in care (OR = 0.14, 95%CI: 0.06, 0.33) and using ART (OR = 0.31, 95%CI: 0.19, 0.50). Participants under 30 were less likely report using ART (OR = 0.53, 95%CI: 0.32, 0.88) compared to BMSM aged 40 and older. Lastly, participants with a college education or college graduates were more likely than those with a high school education to report using ART (OR = 1.69, 95% CI: 1.11, 2.56).

In multivariable logistic regression analyses of syndemic variables and care continuum outcomes, seen in Table 5-3, participants without current insurance coverage were significantly less likely to be in care (AOR = 0.13, 95% CI: 0.05, 0.36) and less likely to report ART use (AOR = 0.33, 95% CI: 0.20, 0.54). In models 2 and 3, analyses of increasing syndemic variable counts found no significant associations for care status or ART use. As these models did not express any additive interplay for variables, no measures of synergy/joint effect are presented to accompany these analyses.

In bivariate analyses, shown in Table 5-4, BMSM under 30 were significantly less likely than men aged 40 and older to have an undetectable viral load (OR = 0.45, 95% CI:0.28, 0.73). Participants earning $30,000 or more were significantly more likely to have an undetectable viral load (OR = 1.54, 95% CI: 1.07, 2.21) and participants lacking insurance coverage were less likely to report an undetectable viral load (OR = 0.56, 95% CI: 0.33, 0.94). There were no other significant associations among demographic variables. In multivariable logistic regression, there

was no association found between time of linkage from diagnosis and undetectable viral load (AOR = 1.22, 95%CI: 0.72, 2.08).

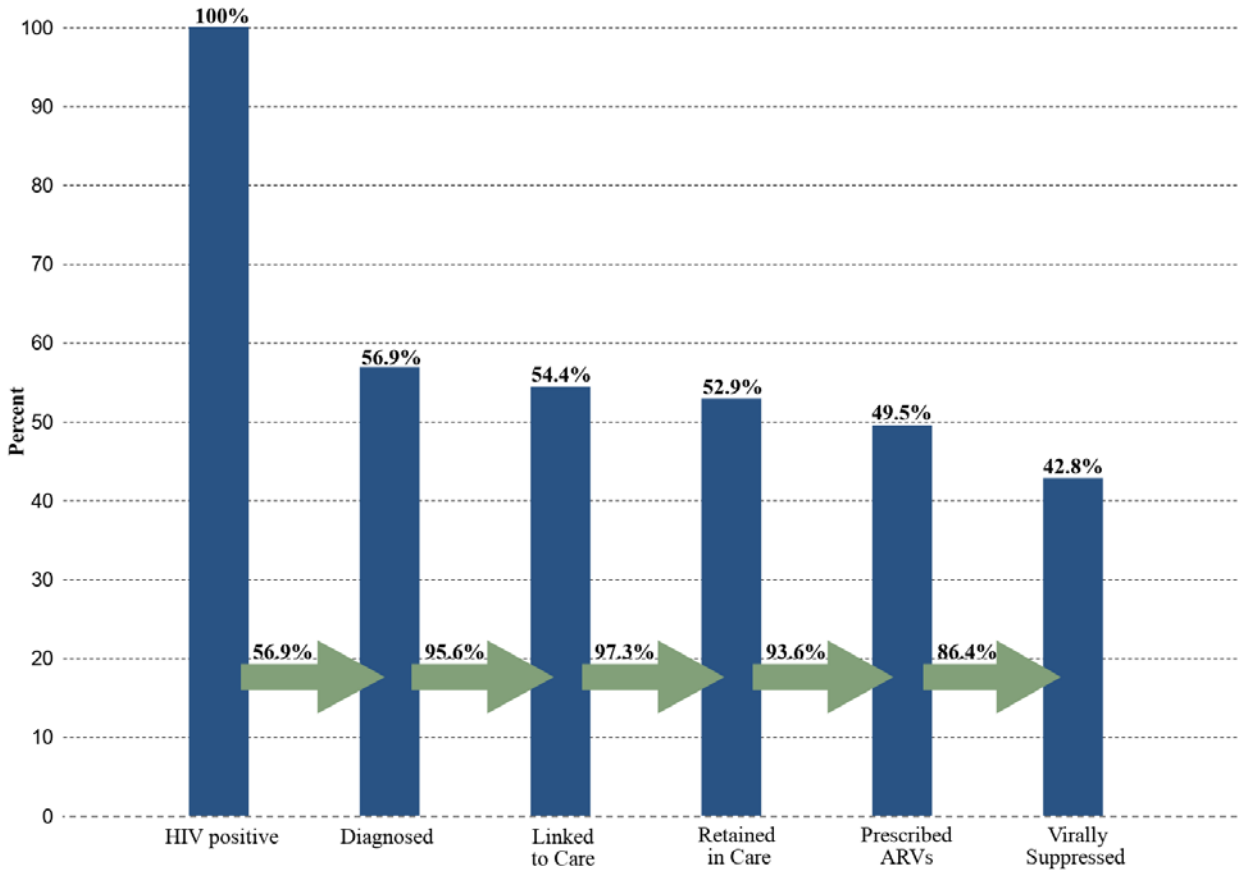


**Figure 5-2 HIV Care Continuum among HIV-positive Black MSM in POWER: United States, 2014-2017**

**Table 5-1 Demographic, Linkage and Syndemic Variables of Seropositive BMSM in the POWER Sample 2014-2017 (N = 925)**

| | In Care Status | | Prescribed ART | | Suppressed Viral Load | |
|---|---|---|---|---|---|---|
| Variable | No (n = 23) | Yes (n = 860) | No (n = 125) | Yes (n = 800) | No (n = 146) | Yes (n = 687) |
| Age | | | | | | |
| 18-29 | 12 (52.2) | 396 (46.1) | **72 (57.6)** | **361 (45.1)** | **87 (59.6)** | **295 (42.9)** |
| 30 - 39 | 7 (30.4) | 247 (28.7) | **31 (24.8)** | **230 (28.8)** | **34 (23.3)** | **205 (29.8)** |
| 40 and older | 4 (17.4) | 217 (25.2) | **22 (17.6)** | **209 (26.1)** | **25 (17.1)** | **187 (27.2)** |
| Sexual Orientation | | | | | | |
| Homosexual/Gay | 22 (95.7) | 759 (88.3) | 109 (87.2) | 702 (87.8) | 124 (84.9) | 610 (88.8) |
| Heterosexual/Straight | 0 (0) | 3 (0.4) | 1 (0.8) | 3 (0.4) | 0 (0) | 3 (0.4) |
| Bisexual | 1 (4.4) | 982(10.7) | 14 (11.2) | 89 (11.1) | 20 (13.7) | 70 (10.2) |
| Other | 0 (0) | 6 (0.7) | 1 (0.8) | 6 (0.75) | 2 (1.4) | 4 (0.6) |
| Annual Income | | | | | | |
| $0 – 29,999 | 13 (56.5) | 423 (49.5) | 70 (57.9) | 391 (49.2) | **85 (58.2)** | **325 (47.5)** |
| $30,000 or more | 10 (43.5) | 431 (51.5) | 51 (42.2) | 404 (50.8) | **61 (41.8)** | **359 (52.5)** |
| Education | | | | | | |
| High school or less | 8 (34.8) | 215 (25.0) | **43 (35.5)** | **196 (24.5)** | 44 (30.14 | 159 (23.1) |
| Some college or College | 14 (60.9) | 551 (64.1) | **67 (55.4)** | **516 (64.6)** | 90 (61.6) | 449 (65.4) |
| Post Bac/Graduate | 1 (4.4) | 93 (10.8) | **11 (9.1)** | **87 (10.9)** | 12 (8.2) | 79 (11.5) |
| Relationship Status | | | | | | |
| Single | 19 (82.6) | 632 (74.9) | 92 (76.0) | 585 (74.6) | 105 (73.4) | 506 (75.1) |
| Partnered | 4 (17.4) | 212 (25.1) | 29 (24.0) | 199 (25.4) | 38 (26.6) | 168 (24.9) |
| Current Insurance Coverage | | | | | | |
| No | **10 (43.5)** | **84 (9.8)** | **94 (75.2)** | **726 (90.8)** | **22 (15.1)** | **62 (9.0)** |
| Yes | **13 (56.5)** | **776 (90.2)** | **31 (24.8)** | **74 (9.3)** | **124 (84.9)** | **625 (91.0)** |
| Time-Specific Diagnosis Variables | | | | | | |
| Time to care from diagnosis | | | | | | |
| Linkage > 90 days (0) | 3 (13.6) | 119 (13.9) | **51 (42.9)** | **109 (13.6)** | 22 (15.1) | 91 (13.3) |
| Linkage ≤ 90 days (1) | 19 (86.4) | 739 (86.1) | **68 (57.1)** | **690 (86.4)** | 124 (84.9) | 595 (86.7) |
| Syndemic Variables | | | | | | |
| 3-month poly drug use | | | | | | |
| No | 22 (95.7) | 819 (95.2) | 119 (95.2) | 763 (95.4) | **130 (89.0)** | **663 (96.5)** |
| Yes | 1 (4.3) | 41 (4.8) | 6 (4.8) | 37 (4.3) | **16 (11.0)** | **24 (3.5)** |
| Depression (CESD-10) | | | | | | |
| No | 13 (56.5) | 485 (56.4) | 75 (60.0) | 451 (56.4) | **62 (42.5)** | **403 (58.7)** |
| Yes | 10 (43.5) | 375 (43.6) | 50 (40.0) | 349 (43.6) | **84 (57.5)** | **284 (41.3)** |
| Intimate Partner Violence (12 mts) | | | | | | |
| No | 21 (91.3) | 710 (82.6) | 98 (79.7) | 666 (83.3) | **108 (74.0)** | **582 (84.8)** |
| Yes | 2 (8.7) | 149 (17.4) | 25 (20.3) | 133 (16.7) | **38 (26.0)** | **104 (15.2)** |
| Sexual Risk | | | | | | |
| Lower Risk | 1 (4.3) | 121 (14.1) | 15 (12.0) | 111 (13.9) | 17 (11.6) | 95 (13.8) |
| Higher Risk | 22 (95.7) | 739 (85.9) | 110 (88.0) | 689 (86.1) | 129 (88.4) | 592 (86.2) |
| Problematic Drinking | | | | | | |
| No | 16 (69.6) | 544 (63.3) | 75 (61.0) | 511 (64.0) | 85 (58.2) | 446 (65.0) |
| Yes | 7 (30.4) | 315 (36.7) | 48 (39.0) | 288 (36.0) | 61 (41.8) | 240 (35.0) |

Notes: In care = participant reports seeing a medical provider for HIV infection in past 12 months; ART = participant reported use of antiretroviral therapy; VL = viral load; percentages are all column percentages; bold type indicates $Chi^2$ test significance of $p \leq .05$

**Table 5-2 Bivariate Analysis of Care status and Antiretroviral Treatment with Demographic and Syndemic Variables of Seropositive BMSM in the POWER Sample 2014-2017 (N = 925)**

| Demographic Variable | In Care Status (n = 898) | | ART Use (n = 925) | |
|---|---|---|---|---|
| | OR | 95% CI | OR | 95% CI |
| Age | | | | |
| 18-29 | 0.61 | 0.19 – 1.09 | 0.53* | 0.32 – 0.88 |
| 30 – 39 | 0.65 | 0.19 – 2.25 | 0.78 | 0.44 – 1.39 |
| 40 and older (ref) | 1.0 | | | |
| Sexual Orientation | | | | |
| Homosexual/Gay (ref) | 1.0 | | 1.0 | |
| Heterosexual/Straight | 1.0 | -- | 0.47 | 0.05 – 4.52 |
| Bisexual | 2.67 | 0.36 – 20.01 | 0.99 | 0.54 – 1.80 |
| Other | 1.0 | -- | 0.93 | 0.11 – 7.81 |
| Annual Income | | | | |
| $0 – 29,999 (ref) | 1.0 | | 1.0 | |
| $30,000 or more | 1.32 | 0.57 – 3.05 | 1.42 | 0.96 – 2.09 |
| Education | | | | |
| High school or less (ref) | 1.0 | | 1.0 | |
| Some college or College | 1.46 | 0.61 – 3.5 | 1.69* | 1.11 – 2.56 |
| Post Bac/Graduate | 3.46 | 0.43 – 28.06 | 1.74 | 0.85 – 3.52 |
| Relationship Status | | | | |
| Single (ref) | 1.0 | | 1.0 | |
| Partnered | 1.59 | 0.54 – 4.74 | 1.08 | 0.69 – 1.69 |
| Current Insurance Coverage | | | | |
| No | 0.14* | 0.06 – 0.33 | 0.31* | 0.19 – 0.50 |
| Yes (ref) | 1.0 | | 1.0 | |
| Syndemic Variables | | | | |
| 3-month poly drug use | | | | |
| No (ref) | 1.0 | | 1.0 | |
| Yes | 1.10 | 0.14 - 8.37 | 0.96 | 0.40 – 2.33 |
| Depression (CESD-10) | | | | |
| No (ref) | 1.0 | | 1.0 | |
| Yes | 1.01 | 0.44 – 2.32 | 1.16 | 0.79 – 1.70 |
| Intimate Partner Violence (12 mts) | | | | |
| No (ref) | 1.0 | | 1.0 | |
| Yes | 2.20 | 0.51 – 9.50 | 0.78 | 0.49 – 1.26 |
| Sexual Risk | | | | |
| Lower Risk (ref) | 1.0 | | 1.0 | |
| Higher Risk | 0.28 | 0.04 – 2.08 | 0.85 | 0.48 – 1.50 |
| Problematic Drinking | | | | |
| No (ref) | 1.0 | | 1.0 | |
| Yes | 1.32 | 0.53 – 3.25 | 0.89 | 0.60 – 1.30 |

OR = odds ratio, *p≤.05, Some parameters could not be estimated due to lack of variability among the dependent variable denoted with --

**Table 5-3 Logistic Regression Analyses to Evaluate the Association between Syndemic Variable Counts and HIV Care Continuum Outcomes of Seropositive BMSM in the POWER Sample 2014-2017**

| Model | AOR | 95% CI | AOR | 95% CI |
|---|---|---|---|---|
| | In Care Status | | ART Use | |
| Model 1 | | | | |
| Age | | | | |
| 18-29 | 0.59 | 0.18 – 1.96 | 0.58 | 0.34 – 1.60 |
| 30 – 39 | 0.65 | 0.18 – 2.39 | 0.91 | 0.49 – 1.70 |
| 40 and older (ref) | 1.0 | | 1.0 | |
| Sexual Orientation | | | | |
| Homosexual/Gay (ref) | 1.0 | | 1.0 | |
| Heterosexual/Straight | 1.0 | -- | 0.26 | 0.26 – 2.63 |
| Bisexual | 3.04 | 0.39 – 23.98 | 1.07 | 0.56 – 2.06 |
| Other | 1.0 | -- | 0.86 | 0.10 – 7.68 |
| Annual Income | | | | |
| $0 – 29,999 (ref) | 1.0 | | 1.0 | |
| $30,000 or more | 0.87 | 0.32 – 2.16 | 1.04 | 0.61 – 3.03 |
| Education | | | | |
| High school or less (ref) | 1.0 | | 1.0 | |
| Some college or College | 1.19 | 0.47 – 3.16 | 1.46 | 0.93 – 2.31 |
| Post Bac/Graduate | 1.61 | 0.17 – 14.91 | 1.36 | 0.61 – 3.03 |
| Relationship Status | | | | |
| Single (ref) | 1.0 | | 1.0 | |
| Partnered | 1.50 | 0.48 – 4.63 | 1.04 | 0.65 – 1.65 |
| Current Insurance Coverage | | | | |
| No | 0.13* | 0.05 – 0.36 | 0.33* | 0.20 – 0.54 |
| Yes (ref) | 1.0 | | 1.0 | |
| Model 2 | | | | |
| Syndemic = 0 (ref) | 1.0 | | | |
| Syndemic = 1 | 1.54 | 0.17 – 13.79 | | |
| Syndemic = 2 | 2.14 | 0.24 – 19.34 | | |
| Syndemic = 3 | 1.18 | 0.18 – 17.83 | | |
| Syndemic = 4 | 1.0 | -- | | |
| Syndemic = 5 | 1.0 | -- | | |
| Model 3 | | | | |
| Syndemic = 0 (ref) | | | 1.0 | |
| Syndemic = 1 | | | 0.54 | 0.16 – 1.88 |
| Syndemic = 2 | | | 0.45 | 0.13 – 1.55 |
| Syndemic = 3 | | | 1.06 | 0.28 – 3.97 |
| Syndemic = 4 | | | 1.53 | 0.27 – 8.55 |
| Syndemic = 5 | | | 0.33 | 0.06 – 1.93 |

AOR = adjusted odds ratio when controlling for demographic variables, city and year of data collection, *p≤.05, Some parameters could not be estimated due to lack of variability among the dependent variable denoted with --

**Table 5-4 Bivariate and Logistic Analysis of Reporting Undetectable Viral Load with Time-specific Linkage and Demographic Variables of Seropositive BMSM in the POWER Sample 2014-2017 (N = 833)**

| Demographic Variable | OR | 95% Confidence Interval | AOR | 95% Confidence Interval |
|---|---|---|---|---|
| Age | | | | |
| 18 – 29 | 0.45* | 0.28 – 0.73 | 0.43* | 0.26 – 0.71 |
| 30 – 39 | 0.81 | 0.46 – 1.40 | 0.69 | 0.39 – 1.23 |
| 40 and older (ref) | 1.0 | | | |
| Sexual Orientation | | | | |
| Homosexual/Gay (ref) | 1.0 | | | |
| Bisexual | 0.71 | 0.42 – 1.21 | 0.72 | 0.41 – 1.26 |
| Other | 0.41 | 0.07 – 2.24 | 0.39 | 0.06 – 2.32 |
| Annual Income | | | | |
| $0 – 29,999 (ref) | 1.0 | | | |
| $30,000 or more | 1.54* | 1.07 – 2.21 | 1.30 | 0.87 – 1.96 |
| Education | | | | |
| High school or less (ref) | 1.0 | | | |
| Some college or College | 1.38 | 0.92 – 2.07 | 1.12 | 0.72 – 1.74 |
| Post Bac/Graduate | 1.82 | 0.91 – 3.64 | 1.19 | 0.56 – 2.54 |
| Relationship Status | | | | |
| Single (ref) | 1.0 | | | |
| Partnered | 0.92 | 0.61 – 1.38 | 0.87 | 0.57 – 1.33 |
| Current Insurance Coverage | | | | |
| No | 0.56 | 0.33 – 0.94 | 0.64 | 0.36 – 1.13 |
| Yes (ref) | 1.0 | | | |
| Time-Specific Linkage Variable | | | | |
| Time to care from diagnosis | | | | |
| Linkage > 90 days (ref) | 1.0 | | | |
| Linkage ≤ 90 days | 1.16 | 0.70 – 1.92 | 1.22 | 0.72 – 2.08 |

OR = unadjusted odds Ratio, AOR = adjusted odds ratio when controlling for demographic variables, city and year of data collection, *p≤.05

## 5.4 DISCUSSION

This study is one of the first to apply the theory of syndemics to BMSM by examining demographic, linkage and individual factors' impact on HIV care continuum outcomes. This analysis suggests that using a syndemic model focusing on individual-level exposures and behavior alone does not entirely explain the lack of BMSM engagement or attrition in the care continuum.

Results of the syndemic count analysis in Table 5-3 did not support the hypothesis that BMSM experience significant decreases in care continuum engagement with an increasing number of syndemic variables. Taken together, this analysis supports the assertion of a critical literature review and meta-analysis that shared that behavioral factors alone could not account for the excess disease burden nor lack of care continuum adherence among BMSM (Millett et al., 2007; Millett et al., 2012; Millett et al., 2006). One possible explanation for these findings are that unlike many of the syndemic studies of urban MSM, which often contained only small samples of non-whites, a syndemic model of structural and social factors may be more robust to discovery of patterns in care disengagement. A 2014 literature review expressed the need to study such factors including HIV healthcare access, provider rapport with patients, the impact of medical mistrust, stigma/discrimination and incarceration in relation to BMSM living with HIV (Maulsby et al., 2014). Such an analysis should be explored in that a lack of current insurance coverage predicted scientifically lower odds of reported care continuum participation in this sample, but was included as a demographic variable; but insurance may have been included in a structural syndemic model.

Secondly, an analysis of time between diagnosis and linkage, using the national benchmark of 90 days, did not significantly impact the viral load outcome of BMSM in this

study. This finding did not support the hypothesis that linkage time alone impacts the viral load status of BMSM. Additional research may benefit in modeling an analysis of time across multiple phases of the care continuum (e.g. participant time from diagnosis to initiation of ART) when modeling the complexity of achieving an undetectable viral load. Further, an additional analysis of linkage time less than 90 days may assist in developing new benchmarks for this essential process.

Although this study has many strengths, there are limitations to these data. This study is cross-sectional in nature and relies heavily on self-report data which are subject to recall bias, however, this allowed the researchers to collect a large sample of data to analyze. Research on self-reports of HIV adherence and viral suppression has been mixed, but a 2006 meta-analysis found that some individuals may be more likely to acquiesce to social desirability bias when told that data would be handled confidentially, however this study was a non-clinical anonymous sample which has not been associated with social desirability (Nieuwkerk & Oort, 2005). Additionally, at least one study of found that individuals were more likely to validly recall viral load when comparing detectable and undetectable viral load as presented in the current analysis (Kalichman, Rompa, & Cage, 2000). Several of the syndemic variables were defined by a single question and it is possible that a single item was not exhaustive or provided a complete catchment of data; however, whenever possible the survey instrumentation used validated measures and scales. Screening for the likelihood of depression was measured using a validated scale, however, due to the nature of depression, it is possible that those most depressed may have been less likely to attend social events where data were collected. The generalizability of the sample may be limited, although the large sample size and national data collection increase confidence in these data and interpretation of results. While it appears that a benefit of this

analysis is that when BMSM where diagnosed they progressed through the care continuum, this left very few men who were not in progressing at each stage with insufficient power to detect differences at each stage.

This analysis is an important step in understanding the complex confluence of factors that impact HIV care continuum engagement among BMSM. As the only syndemic analysis of BMSM focused on care continuum outcomes, this study suggests that more complex methods of theorizing and modeling syndemic variables experienced by BMSM will be necessary in future research. This analysis also calls into question the need to review linkage to HIV care benchmarks for this priority population, offering the opportunity to increase scholarship in addressing the HIV epidemic among BMSM.

# 6.0 CONCLUSION

## 6.1 SUMMARY OF MAIN FINDINGS

The results from these analyses of the Promoting Our Worth Equality and Resilience (POWER) study have contributed new information to research on BMSM and HIV in several different ways. These analyses modeled syndemic production by individual factors, demonstrating the need for more multifaceted models to elucidate additional complexities of HIV-related behavior among BMSM.

The first analysis testing hypotheses related to the age of BMSM most likely to report being testing for HIV in the previous six months as well as the impact of a psychosocial syndemic on HIV screening among HIV negative BMSM in the POWER sample. The hypothesis that older MSM would be more likely to report being screened for HIV in the previous six months was not supported (AOR 2.18, 95% CI: 1.74, 2.72). Further, despite the presence of a syndemic of two psychosocial issues, BMSM in the sample were significantly more likely to report being screened in the previous six months (AOR 1.37, 95% CI: 1.04, 1.80). Syndemics of more than two variables did not have significant associations with reported HIV screening, indicating that perhaps different syndemic variables might explain patterns of reduced screening. Measures of joint effect indices among BMSM who had not been screened for HIV indicated that the greatest synergy was among men who reported poly drug use and depression or

problematic drinking; among men who reported problematic binge drinking with depression, poly drug use or sexual risk. While these joint effects speak to a lack of screening, they account for a minority of BMSM. This study is the first to model HIV screening among BMSM with syndemic variables of this size.

The second analysis focused on hypotheses surrounding the use of PrEP by BMSM. The hypothesis that BMSM who did not use PrEP but had behavioral risk for HIV would have lower odds of reporting current insurance coverage was not supported as Chi squared and bivariate analyses found no significant differences. Further, BMSM in the sample had significantly greater odds of reporting three of the five CDC HIV risk conditions used to determine PrEP initiation: HIV-positive partner in the last 12 months HIV-positive partner (OR = 2.76, 95% CI: 2.06, 3.72), reporting diagnosis of past-year STI (OR = 2.93, 95% CI: 2.22, 3.86) and reporting past year sex work (OR = 2.34, 95% CI: 1.51, 3.62). This finding suggests that healthcare providers are indeed reaching BMSM who are most in need of PrEP. Lastly, findings did not support the hypothesis that PrEP use would decrease as the number of psychosocial variable increased. BMSM in the sample were more significantly more likely to use PrEP when a psychosocial syndemic was present. Among the four variables used in the syndemic, men on PrEP had significantly higher odds for three of the issues: previous 3-month poly drug use (OR = 7.86, 95% CI: 4.28, 14.41), past year intimate partner violence (OR = 4.10, 95% CI: 3.05, 5.52) and problematic binge drinking (OR = 2.01 95% CI: 1.54, 2.62).

Finally, in the third analysis of BMSM living with HIV, research hypotheses were not supported. In multivariable analyses, there were no significant associations among number of reported syndemic variables and a decrease in engagement in the HIV continuum of care for BMSM who reported being in care and those who reported being prescribed antiretroviral

medications. Lastly, there were no significant differences among men who were linked to medical HIV care within the 90-day benchmark period and those who were linked to care more than 90 days after diagnosis.

## 6.2 FUTURE RESEARCH AGENDA

The analyses completed in this dissertation provide compelling reasons to move public health science and theory forward. By using the most often cited psychosocial factors to model syndemic impacts on biobehavioral HIV prevention among BMSM, these analyses have demonstrated the need to search for additional syndemic contributors, namely social and structural factors. While it is clear that individual factors are partially contributing to the HIV epidemic, they cannot completely account for the excess disease burden in this population.

While this research has made novel contributions in exploring the impact of syndemics on HIV-related health behavior and employed the use of joint effects for men not engaging in health behavior, this analysis has not addressed the totality of hazards related to HIV infection and care. It is possible that exploration of additional individual-level factors, such as serosorting may be important, as previous research has reported that BMSM are less likely to engage in the practice (Maulsby et al., 2014). Perhaps more promising will be the exploration of social and structural factors related to HIV. Structurally, there have been requests for additional research related to HIV outcomes such as experiences of homelessness, incarceration and healthcare access (Maulsby et al., 2014). In the social context, greater research is need to examine experiences of stigma/discrimination, internalized homophobia and the impact of social networks on HIV outcomes (Garcia et al., 2016; Maulsby et al., 2014). While much of the current

literature prompts researchers to investigate each of these factors separately, modeling the additive interplay and the synergy among such factors may be key in discovering novel intervention opportunities among BMSM.

POWER, the study used in these analyses collected data from large, urban areas. While this provides a national sample, it may not have been representative of BMSM living in certain regions (i.e. the northwest United States) or BMSM living in rural areas, who may have systematically different experiences than urban BMSM. Nevertheless, this research has been pivotal in assessing the use of syndemic theory with BMSM, given that so few studies have been focused on samples of BMSM. Future research must address quandaries related to these social and structural factors and, when possible, construct studies among BMSM rather than only in comparison to other MSM.

## 6.3 A NECESSARY CALL TO ACTION

As public health practitioners continue to engage in social justice based research, continuous theory development and modeling will be critical. During the last three decades, HIV-specific research has moved beyond reductionist or linear assumptions of disease virology and included ecological models that include social justice imperatives. Using the Beauchamp (1976) model of public health as social justice is a blueprint for the necessary research response of healthcare providers and community agencies alike. The theory of syndemic production proves essential in environments where public health measures do not operate at full capacity, there are globalized diseases, microbial adaptation is possible, there are shifting demographic and social changes or there are changing economic or political conditions (Singer et al., 2017). All of these conditions

are relevant in discussing the challenges presented by the HIV epidemic and worthy of a coordinated response.

A grounding phase of addressing HIV is the control of hazards. While some hazards have been well-documented in the literature (e.g. condomless anal intercourse) others remain understudied (e.g. experiences of healthcare discrimination). The theory of syndemics offers the opportunity to study how hazardous factors may work synergistically to impact health. Modeling these suspected factors within multiple levels of the social ecology provides a framework for prevention of death and disease – the second phase of using public health as social justice (Beauchamp, 1976). Interrupting syndemic pathways has historically been a challenge, as several contributors are social problems such as poverty and marginalization. Syndemics with accompanying joint effects offers a method of providing focal points to intervention. Beauchamp calls on public health professionals to organize prevention responses in collective actions as the third step in the strategy. For example, increasing the strategic and policy implications that guide initiatives like the National HIV/AIDS strategy and use of continua to track progress will be important in addressing BMSM health moving forward. Perhaps the most notable difficulties in using public health as social justice have been attributed to equitable sharing of costs and benefits given the circumstances of marginalized groups, yet, syndemics offers one method of conveying the unique experiences of BMSM by employing methods that increase the understanding of the ways in which HIV-related contributors mutually exacerbate one another. Modeling such adversity is paramount to engaging larger audiences in addressing disparities in prevention and treatment among BMSM. Lastly, it is vital to convey that disparities do not exist in isolation, rather they are bellwethers to shortcomings in the health of our population and public health maintains and integral role in shaping the solutions to these

impediments. A failure to adequately address public health crises in marginalized groups may allow crises to travel upstream to additional populations.

Specific to BMSM who are seronegative, the analyses presented stress the need to examine contributors to health behavior at each level of the social ecology (i.e. individual, social, structural) and to understand that hazards faced by the population. Only when these hazards are understood, can practitioners design interventions and strategies to maximize systems that are in place and suggest improved recommendations with a sustained effect. PrEP continues to be an important tool for HIV prevention, but appears to only be targeting the most at-risk BMSM and a coordinated response must encourage greater uptake. A recent study by Jenness and colleagues (2018) used a mathematical model which estimated that if BMSM had equal parameters on the PrEP continuum of uptake as White MSM, rather than a 23% decline in HIV incidence in 10 years, BMSM would experience a 47% decline in incidence in 10 years. This conveys a great urgency in encouraging PrEP use which may require additional resources but, has the potential to make a meaningful reduction in new cases of HIV among BMSM. Further, these dissertation analyses support previous research that co-location of services with PrEP may assist in dissemination of this biomedical too (Smith et al., 2012)l. Specifically, in this analysis, it appears that partnering with professionals that address depression symptomologies may offer another avenue for PrEP referral.

Similarly, among BMSM living with HIV, the confirmation of resources for both diagnosing BMSM with HIV as well as resources to link men to care are essential. Further, these analyses suggest that a shorter period, perhaps linkage to HIV care within the first month following HIV diagnosis, might impact the navigation of BMSM though to HIV are continuum toward viral suppression.

This dissertation provides insight into the ongoing research needs to address critical shortfalls in the health of BMSM within the United States. Using innovative models that more accurately reflect the impact of multiple factors is key to discovering new barriers in HIV biomedical intervention and forging new solutions to bolster the dissemination of biobehavioral interventions among BMSM.

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