PATTERNS OF CONCURRENT SEXUAL PARTNERSHIPS AMONG NEWLY HIV-DIAGNOSED PERSONS IN NEW YORK CITY, 2007-2017

A DISSERTATION

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Abstract

Concurrency is defined as overlapping sexual partnerships where sexual intercourse with one partner occurs between two acts of intercourse with another partner. The behavior is frequently reported in the literature and can be considered normative within certain groups around the world. Despite this, there are many unanswered questions on the topic, which can impact HIV prevention and control service-delivery programs.

Three studies were conducted among a group of newly HIV-diagnosed persons identified by the New York City Department of Health and Mental Hygiene. First, bivariate analyses were conducted in order to address the differences between those who named their sexual partners and those who did not as well as those who reported sexual partner concurrency and those who did not among those who named their sexual partners. Tests of trend over the ten-year time period were conducted in order to assess trends in both the elicitation of sexual partners, self-report of anonymous sexual partners, and sexual partner concurrency. In the next study, bivariate analyses were conducted in order to identify differences in sexual risk behaviors between those reported sexual partner concurrency and those who did not. Both crude and adjusted logistic regression analyses were conducted in order to determine which sexual risk behaviors were predictors of sexual partner concurrency. In the final study, an additional set of bivariate analyses were conducted to determine differences in substance use behaviors between those who reported sexual partner concurrency and those who did not. Crude and adjusted logistic regression analyses were conducted in order to determine which substance use behaviors were predictors of sexual partner concurrency.

Of the 16345 newly HIV-diagnosed persons eligible for a partner services interview, the majority (83%) were interviewed. Of these 13697 patients, just over half named their sexual
partners (N=6943). Of these, approximately 15% self-reported engagement in sexual partner concurrency. The first study indicated that several demographic differences existed between those who named their sexual partners and those who did not, as well as those who reported sexual partner concurrency and those who did not. In addition, trends indicate that the elicitation of sexual partners is decreasing over time, as is the trend in those reporting sexual partner concurrency. However, there is no linear trend in the self-report of anonymous sexual partners.

The second study showed significant differences between those who reported sexual partner concurrency and those who did not with regard to HIV sexual-risk behavior. Further, several of these behaviors acted as predictors of sexual partner concurrency in both the crude and adjusted models. The third study also showed that there were several significant differences between those who reported sexual partner concurrency with regard to substance use behavior. Several of these behaviors acted as predictors of sexual partner concurrency in both the crude and adjusted models. However, contrary to the hypothesis, more stigmatized drug use (drug use other than or addition to marijuana and injection drug use) did not result in a stronger relationship with sexual partner concurrency compared to less stigmatized drug use.

Concurrent partnerships and accompanying relationship dynamics have implications for HIV programs including prevention, treatment, partner tracing, and notification. The results from this dissertation can be used to improve our understanding of relationship dynamics. This can be used to improve upon HIV service delivery programs, both future and those already in existence.
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Foreword

This dissertation uses a three-manuscript model in lieu of the traditional format. As such, it entails a background, literature review, and a detailed description of the study population and methods. Subsequently, the body of the dissertation consists of three chapters, each its own manuscript relating the overall concept of the dissertation. Summarily, a discussion section incorporates the results of the three manuscripts for an integrative interpretation of the research findings and their public health implications.
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1. Background and Significance

Concurrency, or the overlapping of sexual partnerships over time, is defined as the overlapping sexual partnerships where sexual intercourse with one partner occurs between two acts of intercourse with another partner. This is in contrast to sequential, monogamous partnerships in which there is no overlap of in time. Concurrency is important topic to understand. Not only does it occur in multiple populations around the world, but it may be associated with incidence of Human Immunodeficiency Virus (HIV) and other sexually transmitted infections (STIs) (1-6).

Concurrent sexual relationships have the unique ability to create increased risk for HIV and other STIs for someone who doesn’t practice the behavior in addition for those who practice the behavior as well. Not only is there increased risk to contract HIV and other STIs for the index (the individual who practices concurrency), but also for their partner, who may or may not engage in concurrent sexual relationships, through indirect risk of infection (7).

Concurrent sexual partnerships can create challenges for HIV prevention programs. Contextual issues such as relationship dynamics are often difficult to intervene on. The biological nature of HIV with its acute infection period of high infectivity, lack of symptoms, and close relationship with other STIs adds urgency to prevention and control programs to address the issue.

Concurrent relationships are considered “normative” within certain groups in both quantitative and qualitative research in the United States and around the world. A quantitative study of African American young adults in Durham, South Carolina found that 38% of men and 25% of women engaged in a concurrent relationship in the past 6 months (8). Roughly the same amount of African American women in a sample from Atlanta, Georgia reported sexual partner
In a qualitative study of adults in Swaziland, Rurak et al. found that 57% of men and 71% of women reported ever engaging in a concurrent relationship, while 57% of men and 100% of women reported ever having a partner who engaged in a concurrent sexual relationship (10). In literature from both within and outside of the United States, high rates of concurrency have been documented among men who have sex with men (MSM) (11-16).

Despite the commonness engaging in concurrency, there are still many unanswered questions, specifically, what is the relationship between concurrency and sex and drug risk behavior and whether or not concurrency is increasing over time.

Despite being considered normative, non-monogamous relationships, both consensual and nonconsensual, are often stigmatized by society and healthcare providers. This may result in barriers to receiving and/or continuing healthcare (17-19). Thus, the medical community could stand to benefit from increased literature on the topic of concurrent sexual relationships by becoming more informed on the actual risks involved with the behavior. Individuals who practice the behavior would in turn benefit from more informed care.

Condoms are a cheap and effective method to prevent not only unwanted pregnancies, but also both HIV and other STIs. They are readily accessible in most areas of the world and don’t require interaction with medical providers. Behavioral interventions that promote and emphasize condom use can be implemented with the confidence that this is an effective method to prevent HIV and other STIs (20). However, without targeted, directed messages that address the various types of relationships and the levels of risk of associated with them that are relevant to the community, it is unlikely that these interventions will be effective (21).

Biomedical interventions to prevent HIV acquisition such as pre-exposure prophylaxis (PrEP) among those who are HIV-negative and to prevent onward transmission of HIV such as
treatment as prevention (TasP) among those who are HIV-positive are also highly effective tools to prevent incidence of HIV. However, they too require a better understanding of relationship dynamics.

The relationship context is especially important with regards to HIV prevention programs. Relationship characteristics such as whether or not the relationship is open or closed, age difference of the partners, immigration status, and drug use and the behaviors that surround them impact HIV risk for both partners (22-25). In addition, many of these factors are not static over time and may be episodic, with HIV risk varying over time depending on the behavior that is occurring. A better understanding of how relationship dynamics play a role in HIV prevention and treatment would create more comprehensive, effective, and targeted HIV service delivery programs among the populations at highest risk for disease.

While the topic of sexual partner concurrency has been extensively published on, there are gaps in the literature. Much of the literature that exists comes from Sub-Saharan African countries. Literature that does come from the United States, and much of the literature from Asian countries, tends to focus on men, particularly MSM. There is no literature to date that addresses sexual partner concurrency among those newly diagnosed with HIV.

2. Literature Review

2.1. Relationship Types

Concurrent sexual relationships can be separated into two basic types: either consensual or nonconsensual non-monogamous partnerships or relationships. Consensual non-monogamy occurs when individuals in a relationship mutually agree to non-monogamy. This may include various relationship types including polyamory, polyfidelity, open relationships, and “swinging.” Consensual non-monogamy contrasts nonconsensual non-monogamous relationships. In these
relationships, the partnership is ostensibly monogamous. However, one or both of the partners have outside or extradyadic sexual encounters. There is no open communication about this decision. This is commonly known as “cheating” (26).

Hess et al. identified multiple types of concurrent sexual relationships in a study of STI clinic attendees in Seattle, Washington. These fall under the banner of consensual and non-consensual non-monogamous relationships discussed above. These include:

- **Transitional:** occurs when a committed relationship is ending and one of the partners begins a second partnership while the first was still ongoing. Transitional concurrent relationships may be especially risky for HIV and STI transmission as condom use with the original partnership is often low as there is often the assumption of trust and commitment. As the new partnership begins, the index practicing concurrency may wish to demonstrate trust and intimacy with the new partner through the lack of condom use, thus, avoiding condom use with all sexual partners.

- **Separational:** occurs when main partners are separated from each other due to circumstances such as imprisonment, school, or geography. Sexual contact with other, non-main partners occurs during the period of separation. During this type of concurrency condom use with the main partner is low, while condom use with the non-main (outside) partner is higher.

- **Reactive:** occurs when one partner discovers that the other had been non-monogamous and then had sex with someone else in retaliation. Here, condoms are not usually used with the main partner, but may be used (although not always) with the non-main partner.

- **Compensatory:** occurs when an individual seeks an additional partner to compensate for some perceived deficiency in a primary relationship. These are often referred to as “one-
night stands” or “flings.” Condom use with the main partner is not common or socially acceptable, but may be used with the outside partners. However, these types of partnerships can occur spontaneously, under the influence of drugs and/or alcohol, making consistent condom use more difficult to achieve.

- **Experimental:** having several overlapping, non-committed, short-term relationships. Experiment concurrency provides participants with the ability to explore partnerships with multiple people while remaining uncommitted. However, because these relationships are usually not exclusive, condom use is both common and socially acceptable. Thus, despite exposure to multiple sexual partners, experimental concurrency usually involves the use of condoms.

- **Reciprocal:** occurs when both partners mutually agree to see outside people. In reciprocal concurrent relationships, condoms are usually used with non-main partners, but not with the main partner. These relationships are often called “open.”

- **Group sex** occurs most often with non-main partners. It differs from experimental concurrency as the sexual activity occurs on the same occasion. When these events occur under the influence of drugs and/or alcohol, condom use is lowered.

- **Survival sex** was reported more often by women as sex with partners for money or drugs. This can be in the form of multiple non-main partners or with one main-partner and one or multiple non-main partners. Condom use was common when the exchange was for money. However, when the exchange was for drugs, condoms were not as likely to be used.

- **Sex among co-parents** while in a different main partnership was mentioned in this study. Condom use here is often low in both the main partnership and that with the co-parent.
due to increased intimacy with both partnerships, thus, creating the ideal environment for HIV and STI transmission (27).

Just as there are different types of concurrent sexual relationships, the risk for contracting and transmitting HIV and other STIs vary according to the type of concurrent relationship being practiced (28). A visual depiction of three different types of concurrent relationships, from Warren et al., is depicted in Figure 1. Delva et. al, in their visual depiction of the different types of concurrency includes a visual of a sequential monogamous relationship (Figure 2).

As the time between adolescence (the time during which many individuals begin to engage in romantic interactions) and marriage (settling down) begins to increase, there is an increasing number of “grey area” relationship classifications that do not fall into the traditional spectrum of relationship types such as single, boyfriend/girlfriend, or husband/wife. These include polygamous relationships, polyamorous relationships, hookups, friends with benefits, and other classifications for short and long-term sexual relationships that vary across gender, age, and racial and ethnic groups and around the world (29). Previous literature has found that partner types (main vs. casual or primary vs. non-primary) and relationship context shape the behavior that occurs within them, including condom use and negotiation, perception of risk, and sexual behavior (30, 31). HIV prevention messaging, counseling, and interventions often includes or focuses on the dyadic heterosexual or homosexual couple. However, this notion may be outdated and out of touch with the experience of many couples today; specifically, those at the greatest risk for contracting HIV and other STIs such as men who have sex with men and women concurrently and those who engage in concurrent sexual relationships. A qualitative study of pregnant, HIV-positive women found that many of them indicated they lacked the traditional narrative of a monogamous couple, with lack of partner commitment and concurrency
emerging as themes (32). A study among black men and women in North Carolina found that not only was concurrency common (>25%), but the majority of concurrent partnerships involved a steady partner rather than multiple casual or non-main partners (8). The failure of public health campaigns to include non-traditional relationship types and varying relationship contexts in their messaging result in it not reaching those at greatest risk for contracting and transmitting HIV and other STIs.

2.2. Modeling Concurrency

Several studies exist in the literature that model the impact of concurrency on HIV rates. It has been established that concurrent relationships increase the spread of HIV while sequential monogamous relationships reduce the rate at which it spreads (33). However, established, models are still likely to be flawed, based on the following main concerns:

1. Failure to take into account acute HIV infection (AHI) or the primary infection period,
2. Assuming that male-to-female transmission of HIV is equal to female-to-male transmission, and
3. Failure to take into account coital dilution (sexual partnerships that are considered non-primary have a lower frequency of sexual encounters) (34, 35).

Failure to take into account AHI can result in underestimates, while assuming equal transmissibility and failing to take into account coital dilution can result in overestimates of HIV rates. Studies that take these factors into account are more likely to present mathematical models that are accurate.

In addition to the limitations of mathematical modeling studies mentioned above, issues with regards to poor survey instruments and study designs have been raised by researchers with regard to observational studies (34, 36). For example: Some studies fail to distinguish between
serial monogamous relationships and concurrent ones when they asked if the participant had
multiple sexual partners in the past week or month, with affirmative answers being defined as
concurrent (37). This results in flawed estimates of the impact of concurrency on health-related
behaviors and outcomes. Other studies have used more robust methods of ascertaining
concurrency such as asking participants to recall the start and end dates for all sexual
partnerships during a period of time. Then, asking participants directly if while they were
sexually active with [Person X], did they have any other sexual partners (37). However, the
variability in how concurrency is measured impacts comparability across studies.

2.3. Factors Associated with Concurrency

Personal economics is cited among women as a reason for their engagement in
concurrent sexual partnerships. This has been reported in multiple studies around the world.
Economics, both women’s financial dependence on their partner and their partners’ financial
dependence on them, has been reported as a contributing factor for engagement in concurrent
sexual relationships among women in the United States (38). Women who engage in mafiga
matatu, (women’s multiple concurrent sexual partners, usually three) cite economic concerns
along with increased sexual pleasure as reasons for engaging in the practice in rural Tanzania as
well as South Africa (39, 40). This was echoed in another study in Tanzania as well (41). Also,
women in Zimbabwe cite economic status being a contributing factor to their decision to have
concurrent sexual partners (42). In addition to women who engage in concurrent sexual
relationships, personal economics were cited among women whose partner was engaging in a
concurrent sexual relationship. Economic abuse (such as taking away or not giving money) was
more often reported among women who reported their male sexual partner was engaging in a
concurrent relationship or didn’t know if their male sexual partner was engaging in a concurrent
relationship or didn’t know if their male sexual partner was engaging in a concurrent
sexual relationship, compared to women who did not report their partner as engaging in a concurrent sexual partnership (43). Economic dependence as a motivator for engagement in concurrent sexual partnerships is also seen among men as well as reported in a study of African-American men in Philadelphia (44).

Recent literature has shown that among men, increases in depression and anxiety as measured by the Hopkins Symptoms Checklist-25 (HSCL-25) have been shown to be independently associated with concurrency (45, 46). There is, however, no literature that exists to date that shows the same relationship among women.

There are predictors of concurrency that both men and women report. Marital dissatisfaction and sexual dissatisfaction among both men and women has been highlighted in the literature as a predictor of concurrency. Qualitative research from Tanzania indicates both emotional and sexual dissatisfaction originating from the stable partnership as a factor associated with concurrency (41). Mugweni et al. also had the same findings in focus groups with men and women in Zimbabwe (42) as did Rurak et al. in Swaziland (10).

Culturally defined concepts of masculinity and attitudes towards it have been shown to be independently associated with concurrent sexual relationships (47). This exists in qualitative literature as well. In the United States, concurrency was not only described as normative among African American men, but it was attributed to men’s high sex drive and “natural” desire to engage in a variety of sexual activities (48).

Three concepts of culturally defined masculinity were identified among married Zimbabweans: lust, needing frequent sex, and having satisfying sexual performance (42). In Mexico, concurrency was found to be associated with men's caballerismo (a form of traditional masculinity) (49).
2.4. Concurrency and Condom Use

Low levels of condom use among those engaging in concurrent sexual relationships has been reported in the literature (8, 50, 51). Studies of condom use and among those who engage in concurrent sexual partnerships show low condom use with main sexual partners. One study reported only 7% of male participants who engaged in a concurrent sexual relationship reported using condoms with their spouse (52). A study of partner concurrency status and condom use among women diagnosed with Trichomonas vaginalis found that these women rarely used condoms with their partners, who had high rates of concurrency and low rates of condom use (53). Low condom use has been reported with non-main partners as well (54). Given the low levels of condom use with both main and casual sexual partners, concurrency can contribute significantly to the HIV epidemic.

2.5. Natural History of HIV

Using Fauci et. al’s model of the natural history of HIV, it can be seen in Figure 3 that upon infection with the disease, viral loads are highest in the 12 weeks following infection, also known as primary infection or the acute stage of HIV infection (AHI) (55). The role of the primary infection period and its relationship with modeling the impact of concurrency on HIV rates was has been noted in the literature (33, 56). The impact of AHI is maximized without requiring high rates of partner change when concurrency is occurring (7).

This highly infectious period is when subsequent infections can occur as it is the time when viral load (VL) is highest and CD4 cell counts are lowest. This is also the time period when many individuals also don’t know of their change in serostatus as many tests for the disease cannot identify the virus. The natural history of HIV presents its own challenges to HIV control programs. However, the addition of concurrent relationships to this model can increase
HIV incidence with a synergistic effect since those who are newly infected with the virus can unknowingly transmit it onward to multiple individuals during the stage that they are most infectious.

Not unlike HIV, those infected with other STIs such as chlamydia, gonorrhea, and herpes simplex often don’t know their true status. HIV and other STIs can often be asymptomatic, or its symptoms mimic those of other illnesses or conditions. Of the 1.1 million people infected with HIV in the United States, an estimated 1 in 7 do not know they have the disease, creating a challenge for HIV prevention and control programs (57).

**2.6. State of the Literature on Sexual Partner Concurrency Locally (NYC)**

There is a paucity of literature on the state of sexual partner concurrency locally in New York City (NYC). Of the literature that does exist, it primarily focuses on men. Among MSM, 63% reported sexual partner concurrency and 72% reporting their partners’ engagement in concurrency (11). Among non MSM men, 52% reported sexual partner concurrency in primary partnerships while 57% reported sexual partner concurrency in non-primary partnerships at the start of an intervention designed to increase condom use, reduce concurrent partnering and increase HIV testing among heterosexually active African-American men living in high HIV prevalence areas of NYC (58).

While there are no studies to date that analyze sexual partner concurrency among women in NYC specifically, studies that recruited women in NYC (among other sites) did report on some aspects of concurrency. A qualitative study of the socioecological factors influencing women's HIV risk in the United States used the Bronx in NYC as a one of the study sites. While the percentage of women who engaged in sexual partner concurrency was not identified, 38% of the total sample of women reported being a partner to a man with multiple relationships (59). A
large percentage (64%) of women reported their partner’s engagement in sexual partner concurrency in a different study that also used NYC as a recruitment site (60).

There is no literature to date that details the state of concurrency among transgender women living in NYC.

A 2001 study of stigmatized drug use and sexual risk behavior among NYC (Bushwick district of Brooklyn) youth found that the users of more stigmatized drugs engage in risker sexual behavior than those who use less stigmatized drugs or no drug use at all, including but not limited to, engagement in concurrent sexual partnerships (61).

3. Dissertation Aims and Hypotheses

The purpose of this research was to assess patterns and predictors of sexual partner concurrency among newly HIV-diagnosed persons in NYC. Specifically this dissertation aims to:

Aim 1: Analyze the change in self-reported sexual partner concurrency among newly HIV-diagnosed persons interviewed for partner services over time.

Hypothesis 1: It was hypothesized that there would be an increase in those reporting concurrent sexual partnerships over the 10-year time period.

Aim 2: Better understand the relationship between self-reported concurrent sexual partnerships and HIV-risk behavior.

Hypothesis 2: It is hypothesized that engagement in sexual HIV-risk behavior namely: condomless sex, sex with a known HIV-positive person, sex with a known injection drug user (IDU), men having sex with men (MSM), sex with a MSM among females, and transactional sex will be associated with self-reported engagement in concurrent sexual partnerships.
Aim 3: Better understand the relationship between self-reported concurrent sexual partnerships and drug use.

Hypothesis 3: It is hypothesized that drug and alcohol use will be associated with self-reported engagement in concurrent sexual partnerships with more stigmatized drug use such as drug use other than or in addition to marijuana and injection drug use being more strongly associated with sexual partner concurrency compared to marijuana use only.

4. Materials and Methods

4.1. Overview of Partner Services

Partner Services (PS) refers to the broad array of services offered to persons with specific STIs including but not limited to HIV and their partners. Infected persons are interviewed to elicit information about their partners, who can then be confidentially notified of their possible exposure or potential risk, and subsequently tested. Other activities that are conducted as part of PS are prevention counseling, linkage to medical care, and referrals to medical care and other services. Benefits of PS activities extend from the index patient to their partners and ultimately the community at large. PS emphasizes confidentiality: both that of the index patient and that of their partners. Partners are notified of their possible exposure to infection while protecting the confidentiality of the index. In turn, PS offers the opportunity for a confidential process for partners to become aware of their risk and access appropriate diagnostic, treatment, and prevention services. PS reduces disease transmission rates and the effects of the disease by facilitating the earlier identification and treatment of those previously undiagnosed (62).

Information on PS activities in the Assess Connect Engage Unit (ACE, formerly Field Services Unit) at the NYC DOHMH has been published elsewhere in the literature (63-65). Disease intervention specialists (DIS) routinely conduct PS interviews to elicit sex and needle
sharing partners with HIV-positive clients and assist with linking them to HIV related medical care. Data collected through standard PS interview include sociodemographic characteristics, HIV transmission risk (e.g., MSM, sex with HIV positive individuals, condomless sex, needle-sharing), and recent and lifetime sexual and drug use behaviors. Clinical information is gathered from HIV Surveillance at the NYC DOHMH, a population-based registry of all persons diagnosed with HIV since 2001 and AIDS since 1981. When necessary, chart reviews of the patients’ medical records are conducted.

4.2. Analytic Population

The ACE Unit provides PS to those infected with HIV and assists with linking them to care. Newly HIV-diagnosed persons who were reported to ACE, eligible for services between January 2007 and December 2017, and were interviewed were included in the analysis. Newly HIV-diagnosed persons are eligible for ACE services if they are diagnosed with HIV by a NYC provider, diagnosed by a provider outside of NYC but also a resident of NYC, and ≥13 years of age.

Diagnoses with HIV is confirmed by one of the three following, established methods:

1. Western Blot
   - Western Blot, an antibody detection test, is considered a confirmatory test for HIV. Both venous and finger stick blood samples can be used.

2. Multistep Algorithm
   - The Multistep methodology occurs when the patient is identified using an HIV antibody test (such as OraQuick™) and then is given a confirmatory test for HIV either in the form of a Western Blot or viral load. Anyone with a positive HIV antibody test but no confirmatory test is not considered to be
HIV-positive and thus, not reported as such. The patient must test positive on both the HIV antibody test and the HIV confirmatory test (viral load or Western Blot).

3. **Geenius™:**

   - Geenius™ is a single-use, confirmatory test for the antibodies of HIV types 1 (HIV-1) and 2 (HIV-2) and distinguishes between the two types of the virus. Samples types used to detect HIV using this test include blood via finger stick or a Venus sample, serum, or plasma (Bio-Rad Laboratories INC., Hercules, California).

Newly HIV diagnosed patients are reported to ACE either directly by healthcare providers or via mandatory laboratory reporting to HIV surveillance.

To be included in the upcoming analyses persons must be:

1. Newly diagnosed with HIV
2. Reported to ACE between January 1, 2007 and December 31, 2017
3. Interviewed
4. Named sexual partners

Persons who were not interviewed, refused to name sexual partners, only reported anonymous sexual partners, sexual partners who are out of the country, or no sexual partners were excluded from the analysis as concurrency cannot be determined. Those with only needle sharing partners were not included in this analysis.

4.3. **Instruments**

The instrument used to collect sociodemographic characteristics and HIV transmission risk behavior from HIV-diagnosed individuals is a close-ended questionnaire that is administered
by DIS in ACE of the NYC DOHMH. This instrument is called the Case Investigation Form (CIF). The CIF collects sociodemographic information, testing history, and HIV related risk behavior information from those newly infected with HIV (index cases). Information collected to the CIF comprise the ACE index database.

Information on partners is collected to the Partner Investigation Form (PIF). The PIF collects information on the sex and needle sharing partners of those indexes interviewed by DIS at ACE. This information includes first and last dates of exposure, method of exposure (sex, needle sharing, or both), a physical description of the partner, contacting information, and HIV status when available. Information collected to the PIF comprise the ACE partner database.

The ACE index database and partner database are linked together using an identifier unique to each index.

4. 4. Ascertainment of Sexual Partner Concurrency

Sexual partner concurrency for all three manuscripts was ascertained using the overlapping dates of exposure method. This method was selected as it is the most robust method of ascertaining concurrency. Furthermore, the other two methods would be impractical to implement. During the PS interview, patients are asked about their sexual (and drug sharing) partners from the past year. Using the first method, asking patients if they had multiple sex partners in the time period, would not distinguish between sexual partner concurrency and serial monogamy as patients could have several, non-overlapping, sexual partners in the past year. The one year time period is too large to correctly ascertain sexual partner concurrency. Using the second method, asking patients to recall if they had other sexual partners during the same time period that they were having sex with each sexual partner named, would be more practical than the first method. However, this question is not asked on the PIF by DIS at the NYC DOHMH.
While a SAS code could be written to scan the notes section of the PIF, this is impractical as this information is not systematically collected by DIS. Thus, the third method of using the overlapping dates of exposure method was not only the most practical selection for all three manuscripts, but best utilized the information available.

5. Protocol Approvals

This study was considered exempt by the institutional review boards of Tulane University (Study Number 2018-1975) and the New York City Department of Health and Mental Hygiene (Study Number 19-061).


6.1. Abstract

Despite the effectiveness of partner services programs in the identification of HIV case finding, to date, there have been no studies that have analyzed the elicitation of sexual partner concurrency by such programs. Data from the New York City Department of Health and Mental Hygiene between the years 2007 and 2017 were used. Significance of differences between those who named sexual partners and those who did not as well as self-reported concurrent sexual relationships and those who did not were assessed using bivariate statistics. The Cochran-Armitage Test for Trend in Proportions was used to determine whether trends in time. Of the 13697 patients who were interviewed during the 10-year time period, 6943 named their sexual partners. Of these 14.79% self-reported sexual partner concurrency. Persons from the United States and its dependencies were more likely to report sexual partner concurrency (17.05%) compared to those from outside the United States and its dependencies (11.37%) (p<0.0001). Asian/Pacific islanders were more likely to report sexual partner concurrency (16.85%)
compared to persons of other races (p=0.0140). Those who were between the ages of 13 and 29 years were more likely to report sexual partner concurrency (19.87%) compared to those at older ages (p<0.0001). Persons who did not know how to identify sexually were more likely to report sexual partner concurrency (27%) compared to those who identified as heterosexual/straight (11.57%), gay/lesbian (17.90%), bisexual (25.63%), other (10.34%), or unknown (9.13%). 

Between the years 2007 and 2017 the percentage of interviewed patients who named partners significantly dropped from 56% to 31% (p<0.0001). No linear trend in the self-report of anonymous sexual partners was observed (p=0.3636). Among those who named partners, the percentage of patients who reported sexual partner concurrency also significantly dropped from 19% in 2007 to 7% in 2017 (p<0.0001). The results from this analysis highlight that sexual partner concurrency is common among persons newly diagnosed with HIV. This behavior merits more attention by healthcare providers.

6.2. Introduction

Partner services (PS) refers to the broad array of services offered to persons with specific sexually transmitted infections (STIs) including, but not limited to, HIV and their partners. Infected persons are interviewed to elicit information about their partners, who can then be confidentially notified of their possible exposure or potential risk, and subsequently tested (66). Individuals who report concurrent sexual relationships, defined as the overlapping sexual partnerships where sexual intercourse with one partner occurs between two acts of intercourse with another partner, represent a high priority group for partner services as sexual partner concurrency has been associated with the incidence of HIV and other STIs (1-6). Those partners elicited from newly-HIV diagnosed persons who report sexual partner concurrency may be
eligible for biomedical interventions such post or pre-exposure prophylaxis (PEP or PrEP) for those uninfected, and treatment for the disease for those living with HIV.

HIV PS reduces disease transmission rates and the effects of the disease by facilitating the earlier identification and treatment of those previously undiagnosed (66). It is an effective tool to improve HIV test uptake and case finding (67-69). However, the success of PS is dependent on index cases naming their sexual (and drug sharing) partners. With regards to sexual partner concurrency, the partners of those who practice the behavior may have an increased risk for HIV and other STIs due to the indirect risk of infection (7). Thus, it is essential for PS programs to identify these types of relationships in order to facilitate timely notification and subsequent testing of exposed persons. Despite the effectiveness of PS programs in the identification of HIV case finding, to date, there have been no studies that have analyzed the elicitation of sexual partner concurrency by such programs.

The purpose of this analysis is to assess trends in elicitation of concurrent sexual partners of newly HIV-diagnosed persons interviewed for partner services in New York City (NYC). It is hypothesized that distinct trends in the elicitation of concurrent sexual partners will emerge from the data. The results from this analysis can be used to improve upon HIV service delivery programs, both future and those already in existence.

6.3. Methods

Data Source

The NYC Department of Health and Mental Hygiene’s (DOHMH) Assess Connect Engage Unit (ACE, formerly known as the Field Services Unit) provides partner services (PS) to those infected with HIV and assists with linking them to care. Newly HIV-diagnosed persons who were reported to the ACE, eligible for services between January 2007 and December 2017,
and were interviewed were included in the analysis. Newly HIV-diagnosed persons are eligible for ACE services if they are diagnosed with HIV by a NYC provider, diagnosed by a provider outside of NYC but also a resident of NYC, and ≥13 years of age.

Information on PS activities in the ACE at NYC DOHMH has been published elsewhere in the literature (63-65). Disease intervention specialists (DIS) routinely conduct PS interviews with HIV-positive clients to elicit sex and needle sharing partners and assist with linking them to HIV related medical care. Data collected through the standard PS interview include sociodemographic characteristics, HIV transmission risk (e.g., men with male sex partners (MSM), sex with HIV positive individuals, condomless sex, needle-sharing), and recent and lifetime sexual and drug use behaviors. Clinical information is gathered from HIV Surveillance at the NYC DOHMH, a population-based registry of all persons diagnosed with HIV since 2001 and AIDS since 1981. When necessary, chart reviews of the patients’ medical records are conducted.

The instrument used to collect sociodemographic characteristics and HIV transmission risk behavior from HIV-diagnosed individuals is a close-ended questionnaire that is administered by DIS. This instrument is called the Case Investigation Form (CIF). The CIF collects sociodemographic information, testing history, and HIV related risk behavior information from those newly infected with HIV (index cases). Information collected to the CIF comprise the ACE index database.

The Partner Investigation Form (PIF) collects information on the sex and needle sharing partners of those indexes interviewed by DIS at the ACE. This information includes first and last dates of exposure, method of exposure (sex, needle sharing, or both), a physical description of
the partner, contacting information, and HIV status when available. Information collected to the PIF comprise the ACE partner database.

The ACE index database and partner database are linked together using an identifier unique to each index.

**Statistical Analysis**

Statistical significance of differences between those who named sexual partners and those who did not as well as self-reported concurrent sexual relationships and those who did not were assessed using bivariate statistics, such as the Chi-square test of proportions and Fisher’s exact test. The Cochran-Armitage Test for Trend in Proportions was used to determine whether trends in time exist. To determine statistical significance, an alpha of 0.05 was used for all statistical tests conducted.

**Definitions**

Persons were classified as self-reporting a concurrent sexual relationship if they reported two or more sexual relationships with overlapping dates of exposure during their interview. Persons were classified as not self-reporting a concurrent sexual relationship if they only reported one sexual partner, or multiple sexual partners who did not have overlapping dates of exposure. Men were defined as MSM if they were cisgender men who had male-to-male sexual contact with other men (homosexual contact). This may also include men who had sexual contact with women as well (bisexual contact).

Data were analyzed using Statistical Analysis System (SAS) version 9.4 (SAS Institute, Cary, NC).

**6.4. Results**
Between January 1, 2007 and December 31, 2017 16345 newly HIV-diagnosed persons were reported to the ACE Unit. Of these, the vast majority (83.80%) engaged in a PS interview. Of the 13697 who were interviewed, roughly half (50.70%) named their sexual partners. Of these 6943 patients, 1027 (14.79%) self-reported sexual partner concurrency, leaving 4997 patients who named one sexual partner and 941 patients who named multiple non-concurrent sexual partners (Figure 4). The 6943 patients named 10666 partners during the 10-year time period. The median number of partners named was 1 (range 1, 214). Among those who named >1 partner, the median was 2 (range 2, 214). Among those who reported sexual partner concurrency, the median was 3 (range 2, 214).

Several statistically significant differences emerged between the patients who named partners and those who did not name partners. Females were more likely to name their sexual partners compared to males (58.47% vs. 48.25%, p<0.0001). Persons from younger age groups (13-29 years) were more likely to name their sexual partners compared to persons from all other age groups (56.30% vs. 49.46%, 47.71%, and 44.40%) (p<0.0001). Patients who identified as heterosexual or straight were more likely to name their sexual partners (55.02%) compared to those who identified as gay or lesbian (46.93%), bisexual (46.00%), don’t know/not sure (50.93%), other (46.03%), or unknown (43.15%) (P<0.0001). Persons who use drugs other than or in addition to marijuana were more likely to name their sexual partners (56.74%) compared to those who use marijuana only (51.65%) or didn’t use drugs (48.96%) in the past 12 months (Table 1).

Among patients who named their sexual partner/s, there were several statistically significant differences that emerged between those who reported concurrency and those who did not. Persons from the United States of America and its dependencies were more likely to name
two or more concurrent sexual partners (17.05%) compared to persons from outside the United States of America and its dependencies (11.37%) (p<0.0001). Those in the youngest age group of 13-29 years were more likely to report sexual partner concurrency (19.87%) compared to those who were between the ages of 20-39 years (14.93%), 40-49 years (10.20%), or 50+ years (7.14%) (p<0.0001). Persons who had an unknown education level were more likely to self-report sexual partner concurrency (17.46%) compared to those with known education levels (11.21%, 14.53%, and 13.46%) (p<0.0001). Those who did not know how they identified sexually were more likely to report sexual partner concurrency (2.27%) than those who identified as heterosexual or straight (11.57%), gay or lesbian (17.90%), bisexual (25.63%), other (10.34%), or unknown (9.13%) (p<0.0001). Persons who used marijuana only in the past 12 months were more likely to report sexual partner concurrency (20.77%) compared to those who used any other drugs (18.86%) and those who used no drugs (12.71%) (p<0.0001) (Table 2).

Between the years 2007 and 2017 the percentage of interviewed patients who named partners significantly dropped from 56% to 31%, peaking in 2008 and 2009 at 66% (p<0.0001). Among males, the percentage of interviewed patients who named partners significantly dropped from 52% to 31%, peaking in 2010 at 63% (p<0.0001). Among females, the percentage of interviewed patients who named partners significantly dropped from 61% to 36%, peaking in 2009 at 73% (p<0.0001) (Figure 5).

Between the years 2012 and 2017, the percentage of interviewed patients who self-reported anonymous sexual partners roughly stayed the same (p=0.7367). Among males, the percentage of interviewed patients who self-reported anonymous sexual partners stayed the same (p=0.5592). Among females, the percentage of interviewed patients who self-reported
anonymous sexual partners dropped, although not significantly, from 5% to 2% (p=0.0648) (Figure 6).

Between the years 2007 and 2017, among those who named partners, the percentage of patients who reported sexual partner concurrency also significantly dropped from 19% in 2007 to 7% in 2017 (p<0.0001). Among males, those who reported sexual partner concurrency significantly dropped from 15% to 8%, peaking in 2008 at 25% (p<0.0001). Among females, those who reported sexual partner concurrency significantly dropped from 23% to 7%, peaking in 2008 at 26% (p<0.0001) (Figure 7).

6.5. Discussion

In this analysis several significant differences emerged between those who name their sexual partners and those who do not as well as those who name concurrent sexual partners and those who name either one or multiple non-concurrent sexual partners. In addition, the percentage of newly HIV-diagnosed patients who named their sexual partners decreased over time as well as the percentage of those who named concurrent sexual partners. However, no linear trend in the self-report of anonymous sexual partners was observed.

The results from this analysis are consistent with the literature which finds that concurrent sexual partnerships are normative within certain groups around the world such as MSM, young adults, and women (8-16). During the 10 year data collection period, roughly 15% of patients newly diagnosed with HIV who named their sexual partners self-reported sexual partner concurrency. While in 2008, 1 in 4 interviewed patients who named sexual partners self-reported the behavior (Figure 6). While eliciting partners, PS programs, as well as other HIV service-delivery providers, should be aware of these types of sexual relationships and the frequency at which they occur in order to identify as many persons possible who are in need of
HIV testing or treatment. Furthermore, the identification of exposed HIV-negative persons is essential as these persons have a demonstrated need for pre-exposure prophylaxis (PrEP).

This is the first analysis to date that assessed trends in sexual partner elicitation from a PS program over time. Over the 10 year time period, the naming of sexual partners decreased from 56% in 2007 to 31% in 2017 (Figure 5). Furthermore, while women were more likely to name their sexual partners overall (Figure 5), for most years they were less likely to self-report sexual partner concurrency than men (Figure 7). Self-report was the method used to identify sexual partners in this analysis. It is possible that patients did not feel comfortable naming their partners. Just because they were not named does not mean they are unknown to the patient. HIV PS programs should continue to make the identification of sexual partners a priority in order to provide services to those with a potential need for them. In addition, when eliciting sexual partners from patients, DIS should be conscious of the gender differences in sexual partner reporting that may occur: While men may be less likely to name their sexual partners, they may also be more likely to name concurrent sexual partners who are in need of HIV testing, treatment, or prevention services.

There are two sources that explain a decrease in naming sexual partners and self-report of sexual partner concurrency over the 10 year time period: one is a true decrease and the other is a decrease in reporting. It is unlikely that a true decrease is occurring given that the literature indicates that the average number of lifetime sexual partners is increasing over time (70). Thus, a decrease in reporting is the more likely scenario. It is unclear why there is a significant drop in both the naming of sexual partners and self-reporting of sexual partner concurrency. However, there is some information that helps with the hypothesis as to why this drop occurred. There
were significant changes to HIV environment in the United States over the 10 year time period with regards to the implementation of PS and PrEP.

With regards to the implementation of PS, the ACE unit did transition from a facility based methodology to a city based methodology. At its inception in 2006, ACE originally partnered with 8 facilities in the Bronx, Brooklyn, and Manhattan to assist providers and HIV-diagnosed patients with linkage to care and partner services. The program went citywide in 2014. Although the number of facilities serviced by ACE changed, the methodology of how partners were ascertained and concurrency identified did not change.

With the rise of internet based, geosocial networking applications such as Tinder, Grindr, Jackd, Bumble, etc. that may be used to find sexual partners, the percentage of patients who reported anonymous sexual partners between the years 2012 (when this question was added to the CIF) and 2017 was analyzed in order to determine if patients has more anonymous partners and thus, were unable name them to DIS. No linear trend was identified among the overall, male, or female population (Figure 6).

Finally, during the 10 year time period, there was the addition of PrEP to the HIV prevention landscape. This could have had an impact on the number of sexual partners that a person has due to the idea of risk compensation: that is the increase in certain risk taking behaviors (such as the increase number of sexual partners one has, lack of condom use, etc.) due to a perceived decrease in risk from using PrEP. Risk compensation can undermine prevention efforts. However, risk compensation is unlikely to have impacted this study as if it were to have occurred, we would have expected to see an increase in behaviors such as the number of sex partners one has and/or sexual partner concurrency. When in fact, both the percentage of those
who named partners and self-reported sexual concurrency both decreased over the 10 year time period.

In the absence of secular or programmatic changes, it is possible that stigmatization of sexual partner concurrency could help to explain the drop in both the naming of sexual partners and the self-reporting of sexual partner concurrency. While this study is limited in its ability to determine whether stigmatization is occurring or patients’ experiences with it, there is extensive literature that notes sexual partner concurrency as a behavior that is associated with a lack of receiving and/or continuing healthcare (17-19, 71).

This analysis has some limitations. All data are self-reported and thus, may result in bother over-reporting and under-reporting certain behaviors. One of the main limitations of using PS data is the nature of the data collection itself. PS data is not a survey. It may be collected from multiple sources (interview, chart review, etc.). Information bias is possibility in this analysis. Persons who participated in sexual partner concurrency but were unable or unwilling to name their concurrent partners may be misclassified as not participating in the behavior. Finally, the data were only collected in NYC of NYC residents. Because of this, the results may not be generalizable to other populations outside of NYC, and/or other populations of HIV-positive persons. Even among HIV-positive individuals in NYC, the results may not be generalizable to the population of HIV-positive individuals who were not able or willing to be interviewed or located.

Despite these limitations, there are several strengths to this study. This analysis used the most robust method of ascertaining concurrency: by measuring overlapping dates of exposure for all sexual partners named. This method is superior to methods used in previous studies. The large sample size used in this analysis reduces the possibility of type two error. That is non-rejection
of the null hypothesis when it is in fact false. This study represents an innovative use of partner services data. Finally, the study population of newly HIV-diagnosed persons is novel, as few studies have analyzed sexual partner concurrency in this group of people to date.

This study contributes to the literature on research in the context of routine HIV PS. It is hoped that the results from this analysis will inform HIV service-delivery programs by highlighting the fact that sexual partner concurrency is common among persons newly diagnosed with HIV and this behavior merits more attention by health care providers. In addition, this study stresses the need for PS to not only continue to elicit sexual partners, but also elicit sexual partner concurrency when it is occurring.


7.1 Abstract

There is a paucity of literature that analyzes the link between other high-risk sexual behavior and concurrent sexual relationships. Even less evaluates the relationship among those recently diagnosed with HIV. Data from the New York City Department of Health and Mental Hygiene between the years 2007 and 2017 were used. Bivariate analyses were conducted in order to identify differences in sexual risk behaviors between those reported sexual partner concurrency and those who did not. Crude and adjusted logistic regression analyses were conducted to determine which sexual risk behaviors were associated with sexual partner concurrency. Among the 6943 patients who named their sexual partners, 1027 reported sexual partner concurrency. Compared to those who did not practice concurrency, persons who engaged in the behavior were more likely to be born in the United States of America or one of its dependencies (69.33%), be of younger age, and more likely to self-identify as gay or lesbian.
(43.91%). Men who have sex with men were 1.836 times more likely to report concurrent sexual relationships compared to men without male sex partners (95% Confidence Interval (CI) 1.477, 2.282). Persons with anonymous sex partners in the past 12 months were 1.561 times more likely to report concurrent sexual relationships compared to those without anonymous sex partners (95% CI 1.260, 1.935). Persons with a lifetime history of transactional sex were 1.713 times more likely to report concurrent sexual relationships compared without a history of transactional sex (95% CI 1.360, 2.159). Those who engaged in condomless sex in the past 12 months were 1.380 times more likely to report concurrent sexual relationships compared to those who did not (95% CI 1.169, 2.113). The results indicate that other sexual risk behaviors are associated with concurrency. These findings are highly relevant and can be used to target HIV-prevention messaging.

7.2. Introduction

Concurrent sexual relationships, defined as the overlapping sexual partnerships where sexual intercourse with one partner occurs between two acts of intercourse with another partner, are associated with the incidence of HIV and other sexually transmitted infections (STIs) and play a key role in sustaining these epidemics in populations around the world (1-6). These types of relationships are considered risky sexual behavior and are often a better predictor of infection with an STI than the total number of lifetime partners (72, 73).

Much of the literature surrounding sexual partner concurrency and other sexual risk behaviors focuses on condom use. Despite this, there are conflicting reports. Low levels of condom use among those engaging in concurrent sexual relationships has been reported in the literature (8, 50, 51). Studies of condom use and among those who engage in concurrent sexual relationships show low condom use with main sexual partners. One study reported only 7% of
male participants who engaged in a concurrent sexual relationship reported using condoms with their spouse in Uganda (52). Conversely, a study of men in South Africa found that having multiple sexual partners was actually associated with condom use at last intercourse (74). A comparison of the sexual health history and practices between those in monogamous and consensually non-monogamous relationships found that those who engaged in consensual non-monogamy were more likely to use condoms with both their regular and extradyadic partners (75). Finally, a cohort study of young adult women in Michigan found that when women engaged in sexual partner concurrency, their odds of using condoms increased fourfold (76). The inconsistency of findings indicates the need for further study.

There is a paucity of literature that analyzes the link between other high-risk sexual behavior and concurrent sexual relationships, and even less that evaluates the relationship in those recently diagnosed with HIV. The sexual behaviors of those living with HIV must be better understood in order to prevent them from becoming infected with STIs, including other strains of HIV, and to prevent the spread of HIV and other STIs to those who are currently negative.

This manuscript seeks to better understand the relationship between self-reported concurrent sexual partnerships and HIV-risk behavior among persons newly diagnosed with HIV. It is hypothesized that engagement in sexual HIV-risk behavior will be associated with self-reported engagement in concurrent sexual relationships.

7.3. Methods

Data Source

The NYC Department of Health and Mental Hygiene’s (DOHMH) Assess Connect Engage Unit (ACE, formerly known as the Field Services Unit) provides partner services (PS) to those infected with HIV and assists with linking them to care. Newly HIV-diagnosed persons
who were reported to the ACE, eligible for services between January 2007 and December 2017, and were interviewed were included in the analysis. Newly HIV-diagnosed persons are eligible for ACE services if they are diagnosed with HIV by a NYC provider, diagnosed by a provider outside of NYC but also a resident of NYC, and ≥13 years of age.

Information on PS activities in the ACE at NYC DOHMH has been published elsewhere in the literature (63-65). Disease intervention specialists (DIS) routinely conduct PS interviews with HIV-positive clients to elicit sex and needle sharing partners and assist with linking them to HIV related medical care. Data collected through the standard PS interview include sociodemographic characteristics, HIV transmission risk (e.g., men with male sex partners (MSM), sex with HIV positive individuals, condomless sex, needle-sharing), and recent and lifetime sexual and drug use behaviors. Clinical information is gathered from HIV Surveillance at the NYC DOHMH, a population-based registry of all persons diagnosed with HIV since 2001 and AIDS since 1981. When necessary, chart reviews of the patients’ medical records are conducted.

The instrument used to collect sociodemographic characteristics and HIV transmission risk behavior from HIV-diagnosed individuals is a close-ended questionnaire that is administered by DIS. This instrument is called the Case Investigation Form (CIF). The CIF collects sociodemographic information, testing history, and HIV related risk behavior information from those newly infected with HIV (index cases). Information collected to the CIF comprise the ACE index database.

The Partner Investigation Form (PIF) collects information on the sex and needle sharing partners of those indexes interviewed by DIS at the ACE. This information includes first and last dates of exposure, method of exposure (sex, needle sharing, or both), a physical description of
the partner, contacting information, and HIV status when available. Information collected to the PIF comprise the ACE partner database.

The ACE index database and partner database are linked together using an identifier unique to each index.

Statistical Analysis

Statistical significance of differences between those who self-reported concurrent sexual relationships and those who did not were assessed using bivariate statistics, such as the Chi-square test of proportions and Fisher’s exact test. Multiple models were constructed. Unadjusted and adjusted odds ratios (OR and aOR) were calculated along with their corresponding 95% confidence intervals (CI) using individual sexual risk behaviors as the exposures and sexual partner concurrency as the outcome. To determine statistical significance, an alpha of 0.05 was used.

Stratified models were constructed by gender/risk (MSM, cis-gender females, and non-MSM cisgender-men).

Definitions

Men were defined as MSM if they were cisgender men who had male-to-male sexual contact with other men (homosexual contact). This may also include men who had sexual contact with women as well (bisexual contact). Persons were classified as self-reporting a concurrent sexual relationship if they reported two or more sexual relationships with overlapping dates of exposure during their interview. Persons were classified as not self-reporting a concurrent sexual relationship if they only reported one sexual partner, or multiple sexual partners who did not have overlapping dates of exposure.
Data were analyzed using Statistical Analysis System (SAS) version 9.4 (SAS Institute, Cary, NC).

This study was considered exempt by the institutional review boards of Tulane University (Study Number 2018-1975) and The New York City Department of Health and Mental Hygiene (Study Number 19-061).

7.4. Results

Between January 2007 and December 2017, 16345 newly HIV-diagnosed persons were reported to the ACE. 13697 completed a partner services interview. Of the 6943 persons who named at least one sexual partner, 1027 (14.79%) self-reported engaging in concurrent sexual relationships (Figure 1). The majority of the 6943 persons included in this analysis were cisgender male (69.40%), non-Hispanic black (49.90%), and between the ages of 13-29 years (40.70%). Persons originating from the United States of America or one of its dependencies represented the largest group (60.20%).

Demographic and behavioral characteristics between those who engaged in concurrent sexual relationships was compared to those who named one sexual partner and those who named 2 or more partners that were not concurrent. Patients who were born in the United States of America or one of its dependencies were more likely to name concurrent sexual partners (17.05%) compared to those born outside of the United States of America or one of its dependencies (11.37%) or those with an unknown country of origin (12.31%) (p<0.0001). A higher percentage of patients who were between the ages of 13-29 years self-reported sexual partner concurrency (19.87%) compared to patients between the 30-39 years (14.93%), 40-49 years (10.20%), and 50 years and above (7.14%) (p<0.0001). Of the patients who did not know or weren’t sure of how to sexually identify themselves, 27.27% named concurrent sexual
partners. This is higher than those who identified as heterosexual or straight (11.57%), gay or lesbian (17.90%), bisexual (25.63%), other (10.34%) and unknown (9.13%) (p<0.0001). Finally, of the 4815 cisgender men, 18.72% of MSM self-reported their sexual partners, while only 9.17% of non-MSM self-reported their sexual partners (p<0.0001).

After adjustment for race, age, and education, MSM were 1.836 times more likely to report concurrent sexual relationships compared to men without male sex partners (95% CI 1.477, 2.282). After adjustment for gender, race, age, and education, persons who engaged in sex with someone they knew to be HIV positive were 0.685 times as likely to report concurrent sexual relationships compared to those who did not (95% CI 0.544, 0.861). Those who engaged in sex with an IDU in their lifetime were 1.628 times more likely to report concurrent sexual relationships compared to those who did not (95% CI 1.178, 2.248). Persons who had sex with an anonymous sex partner in the past 12 months were 1.561 times more likely to report concurrent sexual relationships compared to those without an anonymous sex partner (95% CI 1.260, 1.935). Persons with a history of transactional sex in their lifetime were 1.713 times more likely to report concurrent sexual relationships compared without a history of transactional sex (95% CI 1.360, 2.159). Those who engaged in condomless sex in the past 12 months were 1.380 times more likely to report concurrent sexual relationships compared to those who did not engage in condomless sex in the past 12 months (95% CI 1.169, 2.113) (Table 3).

Sex with a person known to be HIV-positive in one’s lifetime, sex with a known IDU in the past 12 months, sex with an MSM among women in one’s lifetime and in the past 12 months, a history of transactional sex in the past 12 months, and condomless anal sex were not significant predictors of concurrent sexual relationships in the crude or adjusted analysis (Table 3).
Three subgroup analyses were performed on the following groups: MSM patients (N=3146), cisgender female patients (N=2030), and non-MSM cisgender male patients, (N=1669), and cisgender female patients (N=2030).

Sexual partner concurrency was reported by 18.72% of MSM. MSM who reported sex with a known HIV-positive person in their lifetime were more likely to report sexual partner concurrency compared to those who did not report sex with someone known to be HIV positive (aOR 1.269, 95% CI 1.046, 1.540). MSM who reported sex with a known IDU in their lifetime were more likely to report sexual partner (aOR 1.875, 95% CI 1.137, 3.039). MSM who reported sex with an anonymous partner were more likely to report sexual partner concurrency (aOR 1.473, 95% CI 1.162, 1.868). Finally, a history of transactional sex in one’s lifetime was found to be associated with sexual partner concurrency among MSM (aOR 1.691, 95% CI 1.200, 2.383. Sex with a person who was known to be HIV positive in the past 12 months was found to be protective against reporting sexual partner concurrency in the crude (OR 0.619, 95% CI 0.448, 0.856) but not the adjusted (aOR 0.727, 95% CI 0.486, 1.086) analysis. Similarly, transactional sex in the past 12 months was found to be associated with sexual partner concurrency among MSM in the crude (OR 1.208, 95% CI 1.620, 2.353) but not the adjusted (aOR 1.462, 95% CI 0.574, 3.723) analysis. Condomless sex in the past 12 months and condomless anal sex in the past 12 months was not found to be associated with sexual partner concurrency among MSM in the crude or adjusted analysis (Table 4).

Sexual partner concurrency was reported by 13.50% of cisgender females. Cisgender females who had sex with someone known to be HIV-positive in the past 12 months were found to be less likely to report sexual partner concurrency adjusted (aOR 0.123, 95% CI 0.040, 0.380). Cisgender females who reported sex with an anonymous partner in the past 12 months were
more likely to report sexual partner concurrency (aOR 2.866, 95% CI 1.178, 6.970). A history of transactional sex in cisgender females’ lifetime was found to be associated with sexual partner concurrency (aOR 1.954, 95% CI 1.226, 3.117). Cisgender females who reported condomless sex in the past 12 months were found to be associated with sexual partner concurrency (aOR 1.775, 95% CI 1.280, 2.426). Sex with someone known to be HIV positive in one’s lifetime, sex with an IDU in one’s lifetime and the past 12 months, sex with an MSM, transactional sex in the past 12 months, and condomless anal sex in the past 12 months were not found to be associated with sexual partner concurrency among cisgender females in the crude or adjusted analysis (Table 5).

Sexual partner concurrency was reported by 9.17% of non-MSM cisgender males. Sex with a person known to be HIV-positive in the past 12 months was found to be protective against sexual partner concurrency among non-MSM cisgender males (aOR 0.265, 95% CI 0.088, 0.797). Among non-MSM cisgender males, a history of transactional sex in one’s lifetime was found to be associated with sexual partner concurrency (aOR 1.962, 95% CI 1.244, 3.096). Finally, condomless sex in the past 12 months was found to be associated with sexual partner concurrency among non-MSM cisgender males (aOR 2.024, 95% CI 1.330, 3.080). Sex with a person known to be HIV-positive in one’s lifetime, sex with a person who is an IDU in one’s lifetime and in the past 12 months, sex with anonymous partner, transactional sex in the past 12 months, and condomless anal sex in the past 12 months were not found to be associated with sexual partner concurrency among non-MSM cisgender males in either the crude or adjusted analysis (Table 6).

7.5. Discussion
The results from this analysis indicate that high risk sexual behavior such as men with male sex partners, sex with a person who is an IDU, history of transactional sex in one’s lifetime, sex with anonymous sex partners, and condomless sex are associated with engaging in concurrent sexual relationships. Further, sex with a person who was known to be HIV-positive in the 12 months prior to diagnosis with HIV was found to be negatively associated with engagement in concurrent sexual relationships. When stratified by gender/risk, differences emerged between MSM, non-MSM cisgender men, and females. These findings indicate at several areas for intervention and further research.

The results from this analysis are consistent with results from previous literature. Prior studies have indicated that high risk sexual behavior such as condomless sex is associated with concurrent sexual relationships (8, 50-52). In this sample, those who engaged in condomless sex in the past 12 months were greater than 1.3 times more likely to report concurrent sexual relationships compared to those who did not engage in condomless sex in the past 12 months in the overall analysis. This indicates the need for HIV prevention messaging to continue to stress the importance of condom use for persons with multiple sexual partners in order to prevent the onward spread of HIV and other STIs to those uninfected as well as infection with multiple strains of HIV for those already infected with the virus.

A history of transactional sex in one’s lifetime was associated with concurrent sexual relationships (aOR 1.713, 95% CI 1.360, 2.159) in this analysis. However, transactional sex in the 12 months prior to one’s diagnosis with HIV was found to be protective, although not statistically significant in the crude analysis (OR 0.892, 95% CI 0.551, 1.443) and only marginally associated with concurrent sexual relationships yet still not statistically significant in the adjusted analysis (aOR 1.073, 95% CI 0.545, 2.113). This is suggesting that persons may
modify their sexual risk behavior over time. HIV risk not static. Rather it changes over the
course of one’s lifetime in response to changes in relationship context, health status, age, and
substance use (23-25, 77-81). Providers, when assessing risk for HIV, should take into account
one’s complete lifetime sexual history as opposed to their current risk or past 12 month risk.

In the bivariate analysis, current gender was not found to be associated with engagement
in concurrent sexual relationships (p=0.1021). However, among cisgender men, those with male
sex partners (MSM) were more likely to engage in concurrent sexual relationships in both the
crude (OR 2.282, 95% CI 1.890, 2.757) and adjusted (aOR 1.836, 95% CI 1.477, 2.282) analysis
compared to men without male sex partners (Table 3). Furthermore, in the stratified analysis,
there were differing results between MSM and non-MSM cisgender males emerged. There was a
significant association between sex with an anonymous partner in the past 12 months and sexual
partner concurrency among MSM. However, the results were not significant among non-MSM
cisgender men. Also, condomless sex in the past 12 months was significant among non-MSM
cisgender men, but not among MSM. In many communities around the world, gender norms and
socially constructed beliefs about male sexuality play a significant role in the acceptability and
promoting of engagement in concurrent sexual relationships (42, 47-49, 74). While this study is
limited in its ability to determine the role that society and culture plays in the decision to engage
in concurrent sexual relationships, it highlights an important area for future research. Namely,
how social, cultural, and gender norms surrounding masculinity and male sexuality influence
sexual behavior among cisgender men who have sex with men and those who do not have sex
with men differently. This analysis has some limitations. All data are self-reported and thus, may
result in bother over-reporting and under-reporting certain behaviors. Questions regarding
sensitive issues and taboo topics such as illicit drug use might be underreported due to social
desirability bias. Conversely, the diagnosis of HIV may have altered participants’ perception, resulting in over-reporting of their pre-diagnosis risk behaviors. The length of time between the interview and the behavior in question may also present difficulties with recall, resulting in inaccurate reporting. For example: certain information that is memorable, such as injection drug use, may be reported with ease, while other behaviors that are less salient, such as the number of drinks consumed, may be more easily forgotten. One of the main limitations of using PS data is the nature of the data collection itself. PS data is not a survey. It may be collected from multiple sources (interview, chart review, etc.). Information bias is possibility in this analysis. Persons who participated in sexual partner concurrency but were unable or unwilling to name their concurrent partners may be misclassified as not participating in the behavior. Newly diagnosed persons between the ages of 13 to 17 were included in this analysis as they were eligible to receive services from the ACE unit at the NYC DOHMH. However, while they are included as part of the analysis, they may have differing behavior patterns with regard to sexual risk behavior compared to persons ≥18 years of age. Finally, the data were only collected in NYC of NYC residents. Because of this, the results may not be generalizable to other populations outside of NYC, and/or other populations of HIV-positive persons. Even among HIV-positive individuals in NYC, the results may not be generalizable to the population of HIV-positive individuals who were not able or willing to be interviewed or located. Despite these limitations, there are several strengths to this study. This analysis used the most robust method of ascertaining concurrency: by measuring overlapping dates of exposure for all sexual partners named. This method is superior to methods used in previous studies. The large sample size used in this analysis reduces the possibility of type two error. That is non-rejection of the null hypothesis when it is in fact
false. Finally, the study population of newly HIV-diagnosed persons is novel, as few studies have analyzed sexual partner concurrency in this group of people to date.

In summary, this study investigated the relationship between sexual partner concurrency and other sexual risk behaviors among newly HIV-diagnosed persons in NYC. The results indicate that other sexual risk behaviors are associated with sexual partner concurrency. These findings are highly relevant and can be used to target comprehensive HIV-prevention messaging by providers and public health campaigns.


8.1. Abstract

There are no studies to date that look at the relationship between substance use and its surrounding behaviors with sexual partner concurrency among newly HIV-diagnosed persons. Data from the New York City Department of Health and Mental Hygiene between the years 2007 and 2017 were used. Bivariate analyses were conducted in order to identify differences in drug related behaviors between those reported sexual partner concurrency and those who did not. Crude and adjusted odds ratios (OR and aOR) and their respective 95% confidence intervals (CI) were constructed. Of the 6943 persons who named their sexual partners, 30.87% reported drug use in the past 12 months and 14.79% reported sexual partner concurrency. Compared to persons who reported one sexual partner or multiple non-concurrent partners, persons who engaged in sexual partner concurrency were more likely to report marijuana only use (13.63% vs. 8.82% and 10.10%, p<0.0001) and binge drinking in the 30 days prior to interview (22.88% vs. 16.78% and 19.77%, p<0.0001). Compared to those who did not report drug use in the past 12 months, persons who used marijuana only were more likely to report concurrent sexual relationships
Persons who reported any other drug use other than or in addition to marijuana were also more likely to report concurrent sexual relationships (aOR 1.559, 95% CI 1.328, 1.830). Persons who binge drank in the 30 days prior to their interview were more likely to report concurrent sexual relationships than those who did not (aOR 1.481, 95% CI 1.255, 1.748). Sex while under the influence of drugs or alcohol was found to be associated with sexual partner concurrency (aOR 1.371, 95% CI 1.088, 1.727). The results indicate that substance use and its associated behaviors are associated with sexual partner concurrency.

8.2. Introduction

Substance use has been well established to be a risk factor for HIV and other sexually transmitted infections (STIs) (82-85). Through the lowering of anxiety, self-awareness, inhibitions, and cognizance, persons who engage in substance use and abuse are more likely to engage in risky sexual behavior such as condomless sex, sex with anonymous partners, sex in exchange for money and/or drugs, and sexual partner concurrency. Engagement in concurrent sexual relationships, or sexual relationships that overlap in time, is a high risk-sexual behavior that has not only been associated with incidence of HIV and other STIs, but plays a key role in sustaining these epidemics (1-6).

Previous literature has found alcohol and other substance use to be associated with concurrency (51, 86-93). A 2001 study of stigmatized drug use and sexual risk behavior among New York City (Bushwick district of Brooklyn) youth found that the users of more stigmatized drugs engage in risker sexual behavior than those who use less stigmatized drugs or no drug use at all, including but not limited to, engagement in concurrent sexual partnerships (61). These results are consistent with a 2011 national study of women which found that crack or cocaine use, which is highly stigmatized, was associated with concurrency (prevalence odds ratio 2.72),
and a 2017 study which found that marijuana use was associated with multiple sexual partners among lesbian, gay, and bisexual youth (86, 87). Higher AUDIT (Alcohol Use and Disorders Identification Test) and DAST (Drug Abuse Screening Test) scores, where higher scores are indicative of harmful alcohol use and problems or more frequent drug use in the past year, were found to be associated with sexual partner concurrency in a 2009 study of STI clinic attendees (51).

Substance use behaviors such as sex while drunk and/or on drugs and binge drinking were also shown to be associated with sexual partner concurrency previous literature (87). These behaviors can lower one’s inhibitions and create situations where they are more likely to engage in other high-risk sexual activity such as sex without condom. Thus, it is essential to understand and address the role substance use plays in HIV prevention.

While the topic of substance use and sexual partner concurrency has been researched, these studies often used less robust methods of ascertaining concurrency than using start and end dates for all sexual partners in a given period of time (51, 86, 92, 93). Furthermore, there are no studies to date that look at the relationship between substance use and its surrounding behaviors with sexual partner concurrency among newly HIV-diagnosed persons in the United States. This population represents a subset of persons whose behavior could be intervened upon in order to stem ongoing transmission of HIV.

This manuscript seeks to better understand the relationship between self-reported concurrent sexual partnerships and substance use. It is hypothesized that substance use will be associated with self-reported engagement in concurrent sexual relationships, with more stigmatized drug such drug use other than or in addition to marijuana and injection drug use
being more strongly associated. This study expands upon the current literature on the topic of substance use and concurrency in the context of a recent diagnosis of HIV.

8.3. Methods

Data Source

The NYC Department of Health and Mental Hygiene’s (DOHMH) Assess Connect Engage Unit (ACE, formerly known as the Field Services Unit) provides partner services (PS) to those infected with HIV and assists with linking them to care. Newly HIV-diagnosed persons who were reported to the ACE, eligible for services between January 2007 and December 2017, and were interviewed were included in the analysis. Newly HIV-diagnosed persons are eligible for ACE services if they are diagnosed with HIV by a NYC provider, diagnosed by a provider outside of NYC but also a resident of NYC, and ≥13 years of age.

Information on PS activities in the ACE at NYC DOHMH has been published elsewhere in the literature (63-65). Disease intervention specialists (DIS) routinely conduct PS interviews with HIV-positive clients to elicit sex and needle sharing partners and assist with linking them to HIV related medical care. Data collected through the standard PS interview include sociodemographic characteristics, HIV transmission risk (e.g., men with male sex partners (MSM), sex with HIV positive individuals, condomless sex, needle-sharing), and recent and lifetime sexual and drug use behaviors. Clinical information is gathered from HIV Surveillance at the NYC DOHMH, a population-based registry of all persons diagnosed with HIV since 2001 and AIDS since 1981. When necessary, chart reviews of the patients’ medical records are conducted.

The instrument used to collect sociodemographic characteristics and HIV transmission risk behavior from HIV-diagnosed individuals is a close-ended questionnaire that is administered
by DIS. This instrument is called the Case Investigation Form (CIF). The CIF collects sociodemographic information, testing history, and HIV related risk behavior information from those newly infected with HIV (index cases). Information collected to the CIF comprise the ACE index database.

The Partner Investigation Form (PIF) collects information on the sex and needle sharing partners of those indexes interviewed by DIS at the ACE. This information includes first and last dates of exposure, method of exposure (sex, needle sharing, or both), a physical description of the partner, contacting information, and HIV status when available. Information collected to the PIF comprise the ACE partner database.

The ACE index database and partner database are linked together using an identifier unique to each index.

Statistical Analysis

Statistical significance of differences between those who self-reported concurrent sexual relationships and those who did not were assessed using bivariate statistics, such as the Chi-square test of proportions and Fisher’s exact test. Unadjusted and adjusted odds ratios (OR and aOR) were calculated along with their corresponding 95% confidence intervals (CI). To determine statistical significance, an alpha of 0.05 was used.

Definitions

Drug use was organized by having not used drugs, having used marijuana only, or having used drugs other than or in addition to marijuana in the past 12 months. However, if the patient reported injection drug use (IDU) ever in their lifetime, they were classified as a drug user. Persons were classified as IDU if the received an injection (self-administered or given by another person) of a drug not prescribed by a physician for this person. Persons were classified as self-
reporting a concurrent sexual relationship if they reported two or more sexual relationships with overlapping dates of exposure during their interview. Persons were classified as not self-reporting a concurrent sexual relationship if they only reported one sexual partner, or multiple sexual partners who did not have overlapping dates of exposure.

Data were analyzed using Statistical Analysis System (SAS) version 9.4 (SAS Institute, Cary, NC).

This study was considered exempt by the institutional review boards of Tulane University (Study Number 2018-1975) and The New York City Department of Health and Mental Hygiene (Study Number 19-061).

8.4. Results

Between January 2007 and December 2017, 16345 newly HIV-diagnosed persons were reported to the ACE. 13697 completed a partner services interview. Of the 6943 persons who named at least one sexual partner, 1027 (14.79%) self-reported engaging in concurrent sexual relationships (Figure 1). The majority of the 6943 persons included in this analysis were cisgender male (69.40%), non-Hispanic black (49.90%), and between the ages of 13-29 years (40.70%). Persons originating from the United States of America or one of its dependencies represented the largest group (60.20%). The majority of persons used no drugs in the past 12 months (69.13%). However, 9.71% used only marijuana in the past 12 months while 21.16% used drugs other than or in addition to marijuana.

Demographic and behavioral characteristics between those who engaged in concurrent sexual relationships was compared to those who named one sexual partner and those who named 2 or more partners that were not concurrent. Patients who were born in the United States of America or one of its dependencies were more likely to name concurrent sexual partners.
(17.05%) compared to those born outside of the United States of America or one of its dependencies (11.37%) or those with an unknown country of origin (12.31%) (p<0.0001). A higher percentage of patients who were between the ages of 13-29 years self-reported sexual partner concurrency (19.87%) compared to patients between the 30-39 years (14.93%), 40-49 years (10.20%), and 50 years and above (7.14%) (p<0.0001). Patients who reported only using marijuana in the past 12 months were more likely to report sexual partner concurrency (20.77%) compared to those who used any other drug other than or in addition to marijuana (18.86%) or those who did not report any drug use in the past 12 months (12.71%) (p<0.0001). Patients who reported binge drinking in the 30 days prior to interview were more likely to report sexual partner concurrency (18.71%) than those who did not binge drink in the 30 days prior to interview (13.93%) (Table 2).

After adjustment for gender, race, age, and education, several statistically significant results persisted. Compared to those who used no drugs, persons who used marijuana only were more likely to report concurrent sexual relationships compared to those who did not use drugs (aOR 1.837, 95% CI 1.328, 1.830). Persons who reported any other drug use other than or in addition to marijuana were also more likely to report concurrent sexual relationships compared to those who did not report drug use (aOR 1.559, 95% CI 1.328, 1.830). Persons who binge drank in the 30 days prior to their interview were more likely to report concurrent sexual relationships than those who did not report this behavior (aOR 1.481, 95% CI 1.255, 1.748). Although not statistically significant in the crude analysis, in the adjusted analysis, persons who reported sex while under the influence of drugs or alcohol in the past 12 months were more likely to report concurrent sexual relationships compared to those who did not report this behavior (aOR 1.371, 95% CI 1.088, 1.727) (Table 7).
Injection drug use and the sharing of injection equipment was not found to be associated with sexual partner concurrency in the crude or adjusted analysis (Table 7).

Two subgroup analyses were performed: in persons <30 years of age (N=2842) and in persons ≥30 years of age (N=4119). Patients <30 years were more likely to report sexual partner concurrency compared to patients ≥30 years (19.87% vs. 11.31%, p<0.0001). Patients <30 years were also more likely to report any drug use in the preceding 12 months compared to patients ≥30 years (35.16% vs. 27.92%, p<0.0001) (Results not shown).

In persons <30 years of age, those who used marijuana only and any other drugs other than or in addition to marijuana were more likely to report concurrent sexual relationships compared to those who did not use any drugs in the preceding 12 months (aOR 1.631, 95% CI 1.243, 2.141 and aOR 1.407, 95% CI 1.115, 1.775 respectively). Binge drinking in the 30 days prior to interview was found to be associated with self-report of sexual partner concurrency (aOR 1.416, 95% CI 1.127, 1.780). Injection drug use, the sharing of injection equipment, sex while under the influence of drugs or alcohol in the past 12 months were not found to be associated with sexual partner concurrency in the crude or adjusted analysis (Table 8).

Among persons ≥30 years of age, those who used marijuana only and any other drugs other than or in addition to marijuana were more likely to report concurrent sexual relationships compared to those who did not use any drugs in the preceding 12 months (aOR 2.664, 95% CI 1.862, 3.811 and 1.775, 95% CI 1.426, 2.209). Binge drinking in the 30 days prior to interview was found to be associated with self-report of sexual partner concurrency (aOR 1.619, 95% CI 1.279, 2.051). Finally, sex while under the influence of drugs or alcohol in the past 12 months was found to be associated with sexual partner concurrency (aOR 2.038, 95% CI 1.480, 2.808) (Table 9).
8.5. Discussion

It was hypothesized that substance use would be associated with engagement in concurrent sexual relationships. The results from this analysis supported these expectations with drug use, binge drinking, and sex while under the influence of drugs and alcohol all being predictors of engagement in this behavior in the overall analysis. However, it was also hypothesized that stigmatized drug use would be more associated with sexual partner concurrency than less stigmatized drug use (marijuana only). The results from this analysis do not support this hypothesis. These findings indicate several areas for intervention and future research.

The results from this analysis are consistent with results from previous literature. Prior studies have indicated that substance use is correlated with sexual risk behavior, namely engagement in concurrent sexual relationships (51, 86-93). In this study, marijuana users only were more likely to self-report concurrent sexual relationships in both the crude (OR 1.801, 95% CI 1.468, 2.210) and adjusted (aOR 1.837, 95% CI 1.477, 2.285) analysis, as were users of any other drugs in both the crude (OR 1.596, 95% CI 1.366, 1.865) and adjusted (aOR 1.559, 95% CI 1.328, 1.830) analysis compared to non-drug users. This points to an urgent need for HIV risk reduction interventions to address the role that substance use plays in sexual decision making.

Despite substance use being associated with sexual partner concurrency, injection drug use was found to be protective (although not statistically significant) against sexual partner concurrency in both the crude (OR 0.702, 95% CI 0.471, 1.048) and adjusted (aOR 0.844, 95% CI 0.549, 1.297) analysis. This was unexpected given that in the literature, persons who inject drugs have a high prevalence of sexual risk behaviors such as condomless sex, multiple sex partners, and transactional sex (94-98). In addition, previous literature found that the users of
more stigmatized drugs engage in riskier sexual behavior than those who use less stigmatized drugs or no drug use at all (61). Although there was lack of statistical significance in this study regarding these findings, this may be due to the small sample size (only 219 persons or 15% of drug users reported injecting drugs). These contradictory findings warrant further investigation into the sexual risk behaviors of persons who inject drugs.

Sex while under the influence of drugs or alcohol in the past 12 months was found to be associated with sexual partner concurrency in the adjusted analysis (aOR 1.371, 95% CI 1.088, 1.727) and among patients ≥30 years of age (aOR 2.038, 95% CI 1.480, 2.808). It was found to be associated, but not statistically significant, among those <30 years of age (aOR 1.039, 95% CI 0.748, 1.443). A recent study of drug use among persons living with HIV in Vienna, Austria found that nearly half (44.1%) of those who reported illicit drug use had also reported performing sexual acts they would not do sober (99). While the study did not specify which acts, engagement in concurrent sexual partnerships is a sexual practice that persons may not always engage in if they were sober. Future intervention strategies should highlight the risks of sexual activity under the influence of drugs or alcohol.

Although sex while under the influence of drugs or alcohol in the past 12 months was found to be significantly associated with sexual partner concurrency in the overall adjusted analysis (aOR 1.371, 95% CI 1.088, 1.727) as well among persons ≥30 years of age (aOR 2.038, 95% CI 1.480, 2.808), it was not found to be statistically significant among persons <30 years of age in the adjusted analysis (aOR 1.039, 95% CI 0.748, 1.443) and was found to be protective, although not statistically significant in the crude analysis of those <30 years of age (OR 0.767, 95% CI 0.564, 1.043). It is possible that these findings are reflective of persons of older ages using drugs to enhance their perceived energy and sexual performance. This would be consistent
with a previous study which found that drug use during sex among swingers (defined in this study as heterosexual couples who have sex with others and singles who have sex with these couples) was not only common, but reported to occur due to increased pleasure and energy (100). These findings highlight the need for sexual health providers and HIV risk reduction interventions to acknowledge the perceived benefits of drug and alcohol use during sex.

This analysis has some limitations. All data are self-reported and thus, may result in bother over-reporting and under-reporting certain behaviors. Questions regarding sensitive issues and taboo topics such as illicit drug use might be underreported due to social desirability bias. Conversely, the diagnosis of HIV may have altered participants’ perception, resulting in over-reporting of their pre-diagnosis risk behaviors. The length of time between the interview and the behavior in question may also present difficulties with recall, resulting in inaccurate reporting. For example: certain information that is memorable, such as injection drug use, may be reported with ease, while other behaviors that are less salient, such as the number of drinks consumed, may be more easily forgotten. One of the main limitations of using PS data is the nature of the data collection itself. PS data is not a survey. It may be collected from multiple sources (interview, chart review, etc.). Information bias is possibility in this analysis. Persons who participated in sexual partner concurrency but were unable or unwilling to name their concurrent partners may be misclassified as not participating in the behavior. Newly diagnosed persons between the ages of 13 to 17 were included in this analysis as they were eligible to receive services from the ACE unit at the NYC DOHMH. However, while they are included as part of the analysis, they may have differing behavior patterns with regard to substance use compared to persons ≥18 years of age. Finally, the data were only collected in NYC of NYC residents. Because of this, the results may not be generalizable to other populations outside of NYC, and/or
other populations of HIV-positive persons. Even among HIV-positive individuals in NYC, the results may not be generalizable to the population of HIV-positive individuals who were not able or willing to be interviewed or located.

Despite these limitations, there are several strengths to this study. This analysis used the most robust method of ascertaining concurrency: by measuring overlapping dates of exposure for all sexual partners named. This method is superior to methods used in previous studies. The large sample size used in this analysis reduces the possibility of type two error. That is non-rejection of the null hypothesis when it is in fact false. Finally, the study population of newly HIV-diagnosed persons is novel, as few studies have analyzed sexual partner concurrency in this group of people to date.

In summary, this study investigated the relationship between substance use and sexual partner concurrency among newly HIV-diagnosed persons in NYC. The results indicate that substance use and its associated behaviors are associated with sexual partner concurrency. Future research should focus on the relationship between sexual partner concurrency and drug use, specifically injection drug use. In addition, HIV prevention and intervention programs should take into account the role of substance use in sexual decision making.

9. Discussion

The present dissertation explored patterns and predictors of concurrent sexual relationships among persons newly diagnosed with HIV in NYC between the years 2007 and 2017. The first paper, “Assessing Trends of Self-Reported Concurrent Sexual Behavior Among Newly HIV-Diagnosed Persons in New York City, 2007-2017”, described patterns in partner elicitation and elicitation of sexual partner concurrency among newly HIV-diagnosed persons in NYC. In addition, this paper discussed trends over the ten year time period of partner elicitation,
self-report of anonymous sexual partners, and concurrent sexual relationships. The next paper, “The Association Between Sexual HIV Risk Behavior and Concurrent Sexual Partnerships Among Newly HIV-Diagnosed Persons in New York City, 2007-2017”, evaluated the association between sexual HIV risk behaviors and self-reported sexual partner concurrency. This paper investigated several sexual health behaviors as predictors of concurrency. Results were then stratified by gender/risk (MSM, non-MSM cisgender men, and cisgender females). The final paper, “The Association Between Drug and Alcohol Use and Self-Reported Concurrent Sexual Partnerships Among Newly HIV-Diagnosed Persons in New York City, 2007-2017”, investigated the association between substance use and self-reported sexual partner concurrency. The results of this analysis were stratified by age (<30 years/≥30 years). A detailed summary of findings will be outlined in the next section.

9.1. Summary of Results


Of the 13697 patients who were interviewed, roughly half named their sexual partners (50.70%). Sexual partner concurrency was reported by 14.79% (N=1027) of these patients. There were several significant differences between those who named their sexual partners and those who did not, as well as those who reported sexual partner concurrency and those who did not. Both elicitation of sexual partners and sexual partner concurrency significantly decreased over the ten-year time period (p<0.0001 and p<0.0001 respectively). While females were more likely to name their sexual partners, males were more likely to report sexual partner concurrency. Furthermore, no linear trend was observed in the percentage of patients who reported anonymous sexual partners overall (p=0.7367), or when stratified by current gender (males p=0.5592,
females, 0.0648). The results from this analysis can be used to improve upon current and future HIV PS programs.

The Association Between Sexual HIV Risk Behavior and Concurrent Sexual Partnerships

Among Newly HIV-Diagnosed Persons in New York City, 2007-2017

This study found significant differences between patients who reported sexual partner concurrency and those who did not in terms of their demographics and their pre-HIV diagnoses sexual risk behaviors. High risk sexual behavior such as being MSM (aOR 1.836, 95% CI 1.477, 2.282), sex with a person who is an IDU (aOR 1.628, 95% CI 1.178, 2.248), history of transactional sex in one’s lifetime (aOR 1.713, 95% CI 1.360, 2.159), sex with anonymous sex partners (aOR 1.561, 95% CI 1.260, 1.935), and condomless sex (aOR 1.380, 95% CI 1.169, 1.630) are associated with engaging in concurrent sexual relationships. Further, sex with a person who was known to be HIV-positive in the 12 months prior to diagnosis with HIV was found to be protective against engagement in concurrent sexual relationships (aOR 0.685, 95% CI 0.544, 0.863). When stratified by gender/risk, several differences emerged. Namely that condomless sex in the past 12 months was associated with sexual partner concurrency among non-MSM cisgender men (aOR 2.024, 95% CI 1.330, 3.080) and females (aOR 1.775, 95% CI 1.280, 2.426), but not significant among MSM (aOR 1.092, 95% CI 0.876, 1.362). Further, sex with an anonymous partner was found to be associated with sexual partner concurrency among MSM (aOR 1.473, 95% CI 1.162, 1.868) and females (aOR 2.866, 95% CI 1.178, 6.970), but not significant among non-MSM cisgender men (aOR 1.299, 95% CI 0.660, 2.559). The findings from this study indicate that additional HIV-risk behaviors often accompany sexual partner concurrency. These results can be used to target comprehensive HIV-prevention messaging.
The Association Between Drug and Alcohol Use and Self-Reported Concurrent Sexual Partnerships Among Newly HIV-Diagnosed Persons in New York City, 2007-2017

This study found significant differences between patients who reported sexual partner concurrency and those who did not in terms of their demographics and their pre-HIV diagnoses substance use behaviors. The results from this analysis supported the hypothesis that marijuana use (aOR 1.837, 95% CI 1.477, 2.285), drug use other than or in addition to marijuana (aOR 1.559, 95% CI 1.328, 1.830), binge drinking (aOR 1.481, 95% CI 1.255, 1.748), and sex while under the influence of drugs and alcohol (aOR 1.371, 95% CI 1.088, 1.727) are all being predictors of engagement in sexual partner concurrency. However, it was also hypothesized that stigmatized drug use would be more associated with sexual partner concurrency than less stigmatized drug use (marijuana only). The results from this analysis do not support this hypothesis. Finally, the stratified analysis indicates that the magnitude of association between substance use behaviors and sexual partner concurrency is greater for those ≥30 years of age compared to those <30 years of age. These findings suggest several areas for intervention and research.

9.2. Overall Strengths and Limitations

The biggest strength of all three studies was the large sample size. A full 10 years’ worth of data was used for this analysis for a total of 6943 patients who named their sexual partners (of 13697 total patients who were interviewed) in each of the three papers. A large sample size is essential to reduce type II error and increases generalizability.

Another strength of all three studies was the method by which sexual partner concurrency was ascertained. While the definition of sexual partner concurrency has been universally agreed upon (overlapping sexual partnerships where sexual intercourse with one partner occurs between
two acts of intercourse with another partner), the methods used to ascertain concurrency are
varied with some more accurately capturing true concurrency than others. This dissertation used
the most robust method; overlapping dates of exposure. This method is superior to methods used
in previous studies such as asking if the participant had multiple sexual partners in the past week
or month, which fails to distinguish between serial monogamy and concurrency.

DIS at the NYC DOHMH are thoroughly trained in eliciting sensitive and accurate
information from clients, which helps to minimize the chances of information bias when
conducting interviews using both the CIF and PIF. Extensive DIS training ensures not only
validity of the data collected, but reliability as well.

One limitation of using surveillance data is underreporting, which is common in passive
surveillance systems. However, HIV surveillance in NYC is based on both active and passive
methods. Thus, underreporting of newly HIV-diagnosed cases in less likely than if the system
was passive.

Finally, a great strength of these three studies is their novel study population. To date,
there is a paucity of information on the topic of sexual partner concurrency among those newly
diagnosed with HIV. Furthermore, while the topic of sexual partner concurrency has been
extensively published on, much of the literature that exists comes from Sub-Saharan African
countries. Literature that does come from the United States, and much of the literature from
Asian countries, tends to focus on men, particularly MSM. This dissertation included males and
females in addition to smaller numbers of transgender persons. Finally this dissertation also
focused on a location that is understudied with regard to the topic: a large urban center in the
northeast United States.
Despite these strengths, there are several limitations that are worthy of noting. Information bias could not be completely avoided. All data are self-reported and thus, may result in bother over-reporting and under-reporting certain behaviors. Questions regarding sensitive issues and taboo topics such as illicit drug use might be underreported due to social desirability bias. Conversely, the diagnosis of HIV may have altered participants’ perception, resulting in over-reporting of their pre-diagnosis risk behaviors. The length of time between the interview and the behavior in question may also present difficulties with recall, resulting in inaccurate reporting. For example: certain information that is memorable, such as injection drug use, may be reported with ease, while other behaviors that are less salient, such as sex without a condom, may be more easily forgotten.

The success measuring sexual partner concurrency is premised on persons naming their sexual partners. It is possible that persons who named one sexual partner did in fact have more, possibly concurrent, sexual partners. However, they were unable or unwilling to name these people. Thus, it is likely that sexual partner concurrency is actually under measured in this study.

One of the main limitations of using PS data is the nature of the data collection itself. PS data is not a survey. It may be collected from multiple sources (interview, chart review, etc.).

There was likely to be significant selection bias in this study. Of the 16345 persons reported to ACE during the 10 year time period, 83.80% (N=13697) were interviewed, leaving the remaining 2666 unable to be interviewed due to reasons such as death, unable to locate, or medically unable to respond. Because this group of people includes those who are deceased and medically unable to respond, it is possible that this group of people may have more advanced disease, and thus, less likely to have concurrent sexual partners than the patients who were able to be interviewed. Of the 13697 persons who were interviewed, roughly half (49.30% or
N=6754) did not name their sexual partners due to reasons such as refusal, partners anonymous, or partners out of the country. This has implications to the results of this analysis. It is possible that those who were interviewed but unable or unwilling to name their sexual partners due to social desirability bias or having anonymous sexual partners would be more likely to report sexual partner concurrency. The data were only collected of NYC residents. Because of this, the results may not be generalizable to other populations outside of NYC, and/or other populations of HIV-positive persons. Even among HIV-positive individuals in NYC, the results may not be generalizable to the population of HIV-positive individuals who were not able or willing to be located or interviewed. Furthermore, one limitation of HIV surveillance data is that it is not representative of the entire population as not everyone with the virus is able or willing to be tested and ultimately included in the registry. Thus, certain population subgroups are possibly missed in this analysis.

Finally, newly diagnosed persons between the ages of 13 to 17 were included in this analysis as they were eligible to receive services from the ACE unit at the NYC DOHMH. However, while they are included as part of the analysis, they may have differing behavior patterns with regard to sexual HIV-risk behavior and substance use compared to persons ≥18 years of age. Future analyses will separate out those between the ages of 13 and 17 into their own age group in order to identify differing patterns of sexual HIV-risk behavior and substance use.

9.3. Public Health Implications

There is tremendous public health significance of this dissertation as it ultimately serves to not only improve our understanding of how relationship dynamics influence HIV risk behavior, but this information can also be used to improve upon HIV service delivery programs,
both future and those already in existence. Concurrent partnerships and accompanying relationship dynamics have implications for HIV service delivery programs including prevention, treatment, partner tracing, and notification.

The elicitation of sexual (and drug sharing) partners for PS is essential in controlling the HIV epidemic. Infected persons are interviewed to elicit information about their partners, who can then be confidentially notified of their possible exposure or potential risk, and subsequently tested (1). Persons who test positive for HIV can be swiftly linked to care while those who test negative for HIV can be linked to biomedical interventions such as PEP and PrEP. There is extensive literature to date establishing the effectiveness of PS in the identification of persons who are unaware of their status and also those who are at risk of HIV transmission as well as linking these persons to appropriate care (63, 67-69, 101, 102).

The first study, “Assessing Trends of Self-Reported Concurrent Sexual Behavior Among Newly HIV-Diagnosed Persons in New York City, 2007-2017”, described and summarized trends over time in both partner elicitation, self-report of sexual partner concurrency, and self-report of anonymous sexual partners at a large, urban health department in the northeastern United States. The results from this analysis are consistent with the literature which finds that concurrent sexual partnerships are normative within certain groups around the world such as MSM, young adults, and women (8-16). The findings show that persons who identify their sexual partners and those who do not are different from each other in terms of both their demographics and HIV risk behaviors. Furthermore, differences also exist among those who name their sexual partners, between those who report sexual partner concurrency and those who do not. This has implications for those engaged in PS activities. DIS should be aware of the frequency at which concurrent sexual relationships occur and conscious of collecting full and
complete partner information in order to identify those with a demonstrated need for HIV testing, treatment, and/or prevention activities.

In addition, trends indicate that fewer sexual partners are being elicited over the ten year time period, as well as fewer reports of sexual partner concurrency. However, no linear trend was observed in the self-report of anonymous sexual partners. These findings prompt the need for HIV PS programs to increase their efforts in both the identification of sexual partners, and also sexual partner concurrency when it is occurring as these tasks are essential in controlling the spread of the disease.

DIS should be conscious of the gender differences that exist while eliciting partners and other risk information. Namely, that while women are more likely to name their sexual partners, men are more likely to name concurrent sexual partners. This may have implications for strategies used to interact with newly-HIV diagnosed persons for PS activities.

The next study, “The Association Between Sexual HIV Risk Behavior and Concurrent Sexual Partnerships Among Newly HIV-Diagnosed Persons in New York City, 2007-2017,” focused on the relationship between sexual partner concurrency and other sexual HIV-risk behavior. There were several significant differences with regard to sexual HIV-risk behavior between those who self-reported sexual partner concurrency and those who did not. Also, several sexual risk behaviors acted as predictors of sexual partner concurrency. The results from this analysis were consistent with previous literature which has found an association between condomless sex with concurrent sexual relationships (8, 50-52). They stress the need for HIV prevention messaging to continue to stress the importance of condom use in order to prevent both onward transmission of HIV, but also co-infection with additional strains of HIV and/or
other STIs. In addition, providers should take into account complete lifetime sexual health history, as oppose to current or past 12 month risk.

The final study, “The Association Between Drug and Alcohol Use and Self-Reported Concurrent Sexual Partnerships Among Newly HIV-Diagnosed Persons in New York City, 2007-2017,” analyzed the relationship between sexual partner concurrency and substance use. There were significant differences, with regard to substance use, between those who self-reported sexual partner concurrency and those who did not. Also, several substance use behaviors acted as predictors of sexual partner concurrency. The findings from this study were consistent with previous literature, which has found an association between substance use and sexual partner concurrency (51, 86-93). These findings indicate the need for sexual health providers and HIV risk reduction interventions to acknowledge the perceived benefits of drug and alcohol use during sex and the role that substance use plays in sexual decision making.

When stratified by age the magnitude of association between drug risk behaviors and sexual partner concurrency was larger for those ≥30 years compared to those <30 years for all behaviors analyzed, despite there being a greater percentage of both self-report of sexual partner concurrency and drug use among those <30 years of age. DIS and medical providers should be aware of this finding as drug use and its subsequent behaviors in persons ≥30 may be more predictive of sexual partner concurrency than in persons <30 years of age.

Furthermore, while it was hypothesized that more stigmatized drug use would result in a larger magnitude of association with sexual partner concurrency than marijuana use only, the results from this analysis did not support this hypothesis with the magnitude of association between marijuana only use and sexual partner concurrency being higher than the magnitude of association between any other drug use and sexual partner concurrency. This is not consistent
with previous literature (61). Because this is not consistent with previous literature, this study prompts further research into the role of how different types of drugs, that is those that are more stigmatized than others, influence sexual health behaviors.

9.4. Conclusion and Recommendations

These studies contribute to the literature that exists on sexual partner concurrency by identifying gaps in our understanding of the behavior. The study findings demonstrate that sexual partner concurrency is often accompanied by other HIV-risk behavior, both sexual and related to substance use. In addition, the findings indicate that although sexual partner elicitation and the elicitation of sexual partner concurrency is decreasing over time, the behavior is still quite common among those newly diagnosed with HIV. This dissertation informs future research and interventions, as well as directs PS efforts to continue to stress the need to both identify sexual partners, and sexual partner concurrency when it is occurring. The scaling up of PS activities to address substance use as well as HIV sexual risk behavior is essential to ending the HIV epidemic.
10. Appendix of Tables

<p>| Table 1: Comparison of All Newly HIV-Diagnosed Patients Reported to the Assess. Connect. Engage. Unit and Interviewed for Partner Services who Named Partners and Who Did Not Name Partners, New York City 2007-2017 (Bivariate Statistics) (N=13697) |
|---|---|---|---|
| Variable | Did not name partners N=6754 | Named partners N=6943 | Total (13697) | P Value |
| Current Gender | N (%) | N (%) | N (%) | &lt;0.0001 |
| Male | 5165 (51.75) | 4815 (48.25) | 9980 (100.00) |
| Female | 1442 (41.53) | 2030 (58.47) | 3472 (100.00) |
| Male to Female Transgender | 146 (60.58) | 95 (39.42) | 241 (100.00) |
| Female to Male Transgender | 1 (25.00) | 3 (75.00) | 4 (100.00) |
| Country of Birth | N (%) | N (%) | N (%) | &lt;0.0001 |
| United States of America and its Dependencies | 3743 (47.26) | 4177 (52.74) | 7952 (100.00) |
| Outside of the United States of America | 2999 (52.28) | 2701 (47.72) | 5660 (100.00) |
| Unknown | 52 (44.44) | 65 (55.56) | 117 (100.00) |
| Race/Ethnicity | N (%) | N (%) | N (%) | &lt;0.0001 |
| Non-Hispanic Black | 3253 (48.43) | 3464 (51.57) | 6717 (100.00) |
| Non-Hispanic White | 991 (56.18) | 773 (43.82) | 1764 (100.00) |
| Hispanic/Latino | 2100 (46.57) | 2409 (53.43) | 2509 (100.00) |
| Asian/Pacific Islander | 285 (60.77) | 164 (39.23) | 469 (100.00) |
| Other/Unknown | 123 (52.52) | 113 (47.48) | 238 (100.00) |
| Age Group at Diagnosis | N (%) | N (%) | N (%) | &lt;0.0001 |
| 13-29 Years | 2192 (43.70) | 2824 (56.30) | 5016 (100.00) |
| 30-39 Years | 1725 (50.54) | 1688 (49.46) | 3412 (100.00) |
| 40-49 Years | 1451 (52.29) | 1324 (47.71) | 2775 (100.00) |
| 50+ Years | 1386 (55.60) | 1107 (44.40) | 2493 (100.00) |
| Education* | N (%) | N (%) | N (%) | &lt;0.0001 |
| ≤High School/GED or Equivalent | 2331 (52.97) | 2070 (47.03) | 4401 (100.00) |
| Some College | 1139 (54.71) | 943 (45.29) | 2082 (100.00) |
| Bachelor's/Post Graduate Degree | 1179 (62.55) | 706 (37.45) | 1885 (100.00) |
| Unknown | 2105 (39.50) | 3224 (60.50) | 5329 (100.00) |
| Health Insurance at Diagnosis | N (%) | N (%) | N (%) | &lt;0.0001 |
| Did not name partners N=6754 | 4409 (50.97) | 4241 (49.03) | 8650 (100.00) |
| Sexual Identity | N (%) | N (%) | N (%) | &lt;0.0001 |
| Heterosexual or Straight | 3003 (44.98) | 3673 (55.02) | 6676 (100.00) |
| Gay or Lesbian | 2648 (53.07) | 2519 (46.93) | 5367 (100.00) |</p>
<table>
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<tr>
<th>Category</th>
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<th>Don’t Know/Not Sure</th>
<th>Other</th>
<th>Unknown</th>
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<td>513 (54.00)</td>
<td>437 (46.00)</td>
<td>950 (100.00)</td>
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<td>Past 12 Months Illicit Drug Use</td>
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<td>29 (46.03)</td>
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<td>Marijuana Only</td>
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<td>Any Other Drug Use</td>
<td>197 (47.36)</td>
<td>219 (52.64)</td>
<td>416 (100.00)</td>
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<td>Lifetime Injection Drug Use</td>
<td>177 (50.03)</td>
<td>125 (49.97)</td>
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<td>Sharing of Injection Equipment (N=416)</td>
<td>97 (50.79)</td>
<td>94 (49.21)</td>
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<td>Binge Drinking in the 30 Days Prior to Interview**</td>
<td>1168 (48.18)</td>
<td>1256 (51.82)</td>
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<td>History of Incarceration</td>
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<td>History of Homelessness</td>
<td>893 (45.28)</td>
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<td>Men with Male Sex Partners (MSM) (n=9980)**</td>
<td>3598 (53.35)</td>
<td>3146 (46.65)</td>
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<td>Sex with a Person who is HIV-Positive (Lifetime)</td>
<td>1031 (36.14)</td>
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<td>Sex with a Person who is HIV-Positive (Past 12 Months) (N=2853)</td>
<td>463 (38.42)</td>
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<td>235 (46.91)</td>
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<td>501 (100.00)</td>
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<td>Sex with a Person Who is an Injection Drug User (Past 12 Months) (N=501)</td>
<td>57 (47.28)</td>
<td>60 (52.72)</td>
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<td>Sex with an MSM among women (n=) (Lifetime) (N=3472)</td>
<td>8 (17.78)</td>
<td>37 (82.22)</td>
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<td>Sex with an MSM among women (n=) (Past 12 Months) (N=45)</td>
<td>4 (36.36)</td>
<td>7 (63.64)</td>
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<td>Sex with an Anonymous Partner (Past 12 Months) (N=9667)**</td>
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<td>Transactional Sex**** (Lifetime)</td>
<td>472 (47.77)</td>
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<td>Condomless Sex (Past 12 Months)</td>
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<td>Condomless Anal Sex (Past 12 Months)</td>
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<td>Sex While Drunk and/or High on Drugs (Past 12 Months)</td>
<td>817 (54.25)</td>
<td>689 (45.75)</td>
<td>1506 (100.00)</td>
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*Question Introduced in 2011 (Education); 2012 (Sex with an anonymous partner)
**More than 5 alcoholic drinks in one occasion
***Cisgender males who had ≥1 male sex partner in their lifetime
****Gave or received sex in exchange for money, drugs, or something needed
Table 2: Comparison of All Newly HIV-Diagnosed Patients Reported to the Assess. Connect. Engage. Unit and Interviewed for Partner Services who Engaged in Concurrent Sexual Relationships and those who Did Not Engage in Concurrent Sexual Relationships, New York City 2007-2017 (Bivariate Statistics) (N=6943)

<table>
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<tr>
<th>Variable</th>
<th>Named 1 Partner N=4997</th>
<th>Named 2+ Partners and Not Concurrent N=941</th>
<th>Named 2+ Partners and Concurrent N=1027</th>
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<td>3422 (71.07)</td>
<td>651 (13.52)</td>
<td>742 (15.41)</td>
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<td>Female</td>
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<td>270 (13.30)</td>
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<td>Country of Birth</td>
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<td>Non-Hispanic White</td>
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<td>Hispanic/Latino</td>
<td>1728 (71.73)</td>
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<td>Asian/Pacific Islander</td>
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<td>13-29 Years</td>
<td>1756 (62.18)</td>
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<td>30-39 Years</td>
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<td>40-49 Years</td>
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<td>144 (15.30)</td>
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<td>50+ Years</td>
<td>939 (84.92)</td>
<td>89 (8.04)</td>
<td>79 (7.14)</td>
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<td>Education*</td>
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<td>≤High School/GED or Equivalent</td>
<td>1620 (78.26)</td>
<td>218 (10.53)</td>
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<td>Some College</td>
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<td>0.0003</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>--------------</td>
<td>-------------</td>
<td>-------------</td>
<td>--------</td>
</tr>
<tr>
<td>Sexual Identity</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.000</td>
</tr>
<tr>
<td>Heterosexual or Straight</td>
<td>2824 (76.89)</td>
<td>424 (11.54)</td>
<td>425 (11.57)</td>
<td>1</td>
</tr>
<tr>
<td>Gay or Lesbian</td>
<td>1688 (67.01)</td>
<td>380 (15.09)</td>
<td>451 (17.90)</td>
<td></td>
</tr>
<tr>
<td>Bisexual</td>
<td>232 (53.09)</td>
<td>93 (21.28)</td>
<td>112 (25.63)</td>
<td></td>
</tr>
<tr>
<td>Don’t Know/Not Sure</td>
<td>31 (56.36)</td>
<td>9 (16.36)</td>
<td>15 (27.27)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>15 (51.72)</td>
<td>11 (37.93)</td>
<td>3 (10.34)</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>185 (80.43)</td>
<td>24 (10.43)</td>
<td>21 (9.13)</td>
<td></td>
</tr>
<tr>
<td>Past 12 Months Illicit Drug Use</td>
<td></td>
<td></td>
<td></td>
<td>&lt;0.000</td>
</tr>
<tr>
<td>No Drug Use</td>
<td>3596 (74.92)</td>
<td>594 (12.38)</td>
<td>610 (12.71)</td>
<td>1</td>
</tr>
<tr>
<td>Marijuana Only</td>
<td>439 (65.13)</td>
<td>95 (14.09)</td>
<td>140 (20.77)</td>
<td></td>
</tr>
<tr>
<td>Any Other Drug Use</td>
<td>940 (63.99)</td>
<td>252 (17.15)</td>
<td>277 (18.86)</td>
<td></td>
</tr>
<tr>
<td>Lifetime Injection Drug Use (N=1469)</td>
<td>162 (73.97)</td>
<td>25 (11.42)</td>
<td>32 (14.61)</td>
<td>0.0033</td>
</tr>
<tr>
<td>Sharing of Injection Equipment (N=219)</td>
<td>63 (67.02)</td>
<td>16 (17.02)</td>
<td>15 (15.96)</td>
<td>0.0554</td>
</tr>
<tr>
<td>Binge Drinking in the 30 Days Prior to Interview**</td>
<td>835 (66.48)</td>
<td>186 (14.81)</td>
<td>235 (18.71)</td>
<td>&lt;0.000</td>
</tr>
<tr>
<td>History of Incarceration</td>
<td>638 (67.51)</td>
<td>154 (16.30)</td>
<td>153 (16.19)</td>
<td>0.0127</td>
</tr>
<tr>
<td>History of Homelessness</td>
<td>731 (67.75)</td>
<td>170 (15.76)</td>
<td>178 (16.50)</td>
<td>0.0074</td>
</tr>
<tr>
<td>Men with Male Sex Partners (MSM) (n=4815)***</td>
<td>2064 (65.61)</td>
<td>493 (15.67)</td>
<td>589 (18.72)</td>
<td>&lt;0.000</td>
</tr>
<tr>
<td>Sex with a Person who is HIV-Positive (Lifetime)</td>
<td>1299 (71.30)</td>
<td>230 (12.62)</td>
<td>293 (16.08)</td>
<td>0.1110</td>
</tr>
<tr>
<td>Sex with a Person who is HIV-Positive (Past 12 Months) (N=1822)</td>
<td>597 (80.46)</td>
<td>61 (8.22)</td>
<td>84 (11.32)</td>
<td>&lt;0.000</td>
</tr>
<tr>
<td>Sex with a Person Who is an Injection Drug User (Lifetime)</td>
<td>168 (63.16)</td>
<td>47 (17.67)</td>
<td>51 (19.17)</td>
<td>0.0073</td>
</tr>
<tr>
<td>Sex with a Person Who is an Injection Drug User (Past 12 Months) (N=266)</td>
<td>44 (73.33)</td>
<td>8 (13.33)</td>
<td>8 (13.33)</td>
<td>0.1773</td>
</tr>
<tr>
<td>Sex with an MSM among women (Lifetime) (n=2030)</td>
<td>17 (45.95)</td>
<td>11 (29.73)</td>
<td>9 (24.32)</td>
<td>0.0006</td>
</tr>
<tr>
<td>Sex with an Anonymous Partner (Past 12 Months) (N=37)</td>
<td>5 (71.43)</td>
<td>1 (14.29)</td>
<td>1 (14.29)</td>
<td>0.3646</td>
</tr>
<tr>
<td>Transactional Sex***** (Lifetime)</td>
<td>625 (67.42)</td>
<td>138 (14.89)</td>
<td>164 (17.69)</td>
<td>&lt;0.000</td>
</tr>
<tr>
<td>Transactional Sex***** (Past 12 Months) (N=4394)*</td>
<td>312 (60.47)</td>
<td>96 (18.60)</td>
<td>108 (20.93)</td>
<td>&lt;0.000</td>
</tr>
<tr>
<td>Condomless Sex (Past 12 Months)</td>
<td>3503 (69.15)</td>
<td>754 (14.88)</td>
<td>809 (15.97)</td>
<td>0.6530</td>
</tr>
<tr>
<td>Condomless Anal Sex (Past 12 Months)</td>
<td>55 (79.71)</td>
<td>6 (8.70)</td>
<td>8 (11.59)</td>
<td>0.3126</td>
</tr>
<tr>
<td>Sex While Drunk and/or High on Drugs (Past 12 Months)</td>
<td>481 (69.81)</td>
<td>94 (13.64)</td>
<td>114 (16.55)</td>
<td>0.3757</td>
</tr>
</tbody>
</table>
*Question Introduced in 2011 (Education); 2012 (Sex with an anonymous partner)

**More than 5 alcoholic drinks in one occasion

***Cisgender males who had ≥1 male sex partner in their lifetime

****Gave or received sex in exchange for money, drugs, or something needed
<table>
<thead>
<tr>
<th></th>
<th>Crude Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>Adjusted Odds Ratio*</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men with Male Sex Partners (MSM)</td>
<td>2.282</td>
<td>(1.890, 2.757)</td>
<td>1.836**</td>
<td>(1.477, 2.282)</td>
</tr>
<tr>
<td>Sex with a Person who is HIV-Positive (Lifetime)</td>
<td>1.145</td>
<td>(0.988, 1.327)</td>
<td>1.102</td>
<td>(0.948, 1.281)</td>
</tr>
<tr>
<td>Sex with a Person who is HIV-Positive (Past 12 Months)</td>
<td>0.532</td>
<td>(0.405, 0.699)</td>
<td>0.685</td>
<td>(0.544, 0.863)</td>
</tr>
<tr>
<td>Sex with a Person Who is an Injection Drug User (Lifetime)</td>
<td>1.386</td>
<td>(1.014, 1.895)</td>
<td>1.628</td>
<td>(1.178, 2.248)</td>
</tr>
<tr>
<td>Sex with a Person Who is an Injection Drug User (Past 12 Months)</td>
<td>0.583</td>
<td>(0.258, 1.320)</td>
<td>0.983</td>
<td>(0.482, 2.003)</td>
</tr>
<tr>
<td>Sex with an MSM among women (Lifetime)</td>
<td>2.096</td>
<td>(0.978, 4.491)</td>
<td>2.025**</td>
<td>(0.925, 4.433)</td>
</tr>
<tr>
<td>Sex with an MSM among women (Past 12 Months)</td>
<td>0.458</td>
<td>(0.048, 4.420)</td>
<td>0.494**</td>
<td>(0.029, 8.417)</td>
</tr>
<tr>
<td>Sex with an Anonymous Partner (Past 12 Months)</td>
<td>1.855</td>
<td>(1.517, 2.268)</td>
<td>1.561</td>
<td>(1.260, 1.935)</td>
</tr>
<tr>
<td>Transactional Sex*** (Lifetime)</td>
<td>1.587</td>
<td>(1.269, 1.983)</td>
<td>1.713</td>
<td>(1.360, 2.159)</td>
</tr>
<tr>
<td>Transactional Sex*** (Past 12 Months)</td>
<td>0.892</td>
<td>(0.551, 1.443)</td>
<td>1.073</td>
<td>(0.545, 2.113)</td>
</tr>
<tr>
<td>Condomless Sex (Past 12 Months)</td>
<td>1.446</td>
<td>(1.232, 1.697)</td>
<td>1.380</td>
<td>(1.169, 1.630)</td>
</tr>
<tr>
<td>Condomless Anal Sex (Past 12 Months)</td>
<td>0.754</td>
<td>(0.360, 1.580)</td>
<td>0.703</td>
<td>(0.333, 1.486)</td>
</tr>
</tbody>
</table>

*Adjusting for gender, race, age, and education

**Adjusting for race, age, and education

***Gave or received sex in exchange for money, drugs, or something needed
<table>
<thead>
<tr>
<th></th>
<th>Crude Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>Adjusted Odds Ratio*</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex with a Person who is HIV-Positive (Lifetime)</td>
<td>1.282</td>
<td>(1.059, 1.552)</td>
<td>1.269</td>
<td>(1.046, 1.540)</td>
</tr>
<tr>
<td>Sex with a Person who is HIV-Positive (Past 12 Months)</td>
<td>0.619</td>
<td>(0.448, 0.856)</td>
<td>0.727</td>
<td>(0.486, 1.086)</td>
</tr>
<tr>
<td>Sex with a Person Who is an Injection Drug User (Lifetime)</td>
<td>1.751</td>
<td>(1.071, 2.862)</td>
<td>1.875</td>
<td>(1.137, 3.039)</td>
</tr>
<tr>
<td>Sex with a Person Who is an Injection Drug User (Past 12 Months)</td>
<td>0.367</td>
<td>(0.120, 1.122)</td>
<td>0.192</td>
<td>(0.035, 1.041)</td>
</tr>
<tr>
<td>Sex with an Anonymous Partner (Past 12 Months)</td>
<td>1.478</td>
<td>(1.171, 1.865)</td>
<td>1.473</td>
<td>(1.162, 1.868)</td>
</tr>
<tr>
<td>Transactional Sex** (Lifetime)</td>
<td>1.664</td>
<td>(1.187, 2.333)</td>
<td>1.691</td>
<td>(1.200, 2.383)</td>
</tr>
<tr>
<td>Transactional Sex** (Past 12 Months)</td>
<td>1.208</td>
<td>(1.620, 2.353)</td>
<td>1.462</td>
<td>(0.574, 3.723)</td>
</tr>
<tr>
<td>Condomless Sex (Past 12 Months)</td>
<td>1.130</td>
<td>(0.910, 1.403)</td>
<td>1.092</td>
<td>(0.876, 1.362)</td>
</tr>
<tr>
<td>Condomless Anal Sex (Past 12 Months)</td>
<td>0.518</td>
<td>(0.235, 1.141)</td>
<td>0.568</td>
<td>(0.256, 1.259)</td>
</tr>
</tbody>
</table>

*Adjusting for race, age, and education

**Gave or received sex in exchange for money, drugs, or something needed
Table 5: Logistic Regression Analysis of Sexual Risk Behaviors And Concurrent Sexual Relationships Among Cisgender Female Patients (N=2030)

<table>
<thead>
<tr>
<th></th>
<th>Crude Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>Adjusted Odds Ratio*</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex with a Person who is HIV-Positive (Lifetime)</td>
<td>0.795</td>
<td>(0.583, 1.086)</td>
<td>0.780</td>
<td>(0.567, 1.074)</td>
</tr>
<tr>
<td>Sex with a Person who is HIV-Positive (Past 12 Months)</td>
<td>0.156</td>
<td>(0.061, 0.400)</td>
<td>0.123</td>
<td>(0.040, 0.380)</td>
</tr>
<tr>
<td>Sex with a Person Who is an Injection Drug User (Lifetime)</td>
<td>1.261</td>
<td>(0.758, 2.097)</td>
<td>1.524</td>
<td>(0.895, 2.595)</td>
</tr>
<tr>
<td>Sex with a Person Who is an Injection Drug User (Past 12 Months)</td>
<td>1.038</td>
<td>(0.269, 4.004)</td>
<td>0.868</td>
<td>(0.106, 7.104)</td>
</tr>
<tr>
<td>Sex with an MSM (Lifetime)</td>
<td>2.096</td>
<td>(0.978, 4.491)</td>
<td>2.025</td>
<td>(0.925, 4.433)</td>
</tr>
<tr>
<td>Sex with an MSM (Past 12 Months)</td>
<td>0.458</td>
<td>(0.048, 4.420)</td>
<td>0.494</td>
<td>(0.029, 8.417)</td>
</tr>
<tr>
<td>Sex with an Anonymous Partner (Past 12 Months)</td>
<td>3.163</td>
<td>(1.326, 7.543)</td>
<td>2.866</td>
<td>(1.178, 6.970)</td>
</tr>
<tr>
<td>Transactional Sex*** (Lifetime)</td>
<td>2.000</td>
<td>(1.276, 3.136)</td>
<td>1.954</td>
<td>(1.226, 3.117)</td>
</tr>
<tr>
<td>Transactional Sex*** (Past 12 Months)</td>
<td>0.861</td>
<td>(0.288, 2.574)</td>
<td>1.832</td>
<td>(0.345, 9.731)</td>
</tr>
<tr>
<td>Condomless Sex (Past 12 Months)</td>
<td>1.683</td>
<td>(1.233, 2.296)</td>
<td>1.775</td>
<td>(1.280, 2.426)</td>
</tr>
<tr>
<td>Condomless Anal Sex (Past 12 Months)</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
</tbody>
</table>

*Adjusting for race, age, and education

**Did not converge

***Gave or received sex in exchange for money, drugs, or something needed
Table 6: Logistic Regression Analysis of Sexual Risk Behaviors And Concurrent Sexual Relationships Among Cisgender Males who Don't Have Sex with Men (N=1669)

<table>
<thead>
<tr>
<th></th>
<th>Crude Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>Adjusted Odds Ratio*</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex with a Person who is HIV-Positive (Lifetime)</td>
<td>1.018</td>
<td>(0.685, 1.513)</td>
<td>0.960</td>
<td>(0.641, 1.436)</td>
</tr>
<tr>
<td>Sex with a Person who is HIV-Positive (Past 12 Months)</td>
<td>0.398</td>
<td>(0.169, 0.937)</td>
<td>0.265</td>
<td>(0.088, 0.797)</td>
</tr>
<tr>
<td>Sex with a Person Who is an Injection Drug User (Lifetime)</td>
<td>1.363</td>
<td>(0.639, 2.908)</td>
<td>1.356</td>
<td>(0.625, 2.943)</td>
</tr>
<tr>
<td>Sex with a Person Who is an Injection Drug User (Past 12 Months)</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>Sex with an Anonymous Partner (Past 12 Months)</td>
<td>1.505</td>
<td>(0.780, 2.907)</td>
<td>1.299</td>
<td>(0.660, 2.559)</td>
</tr>
<tr>
<td>Transactional Sex*** (Lifetime)</td>
<td>1.953</td>
<td>(1.255, 3.038)</td>
<td>1.962</td>
<td>(1.244, 3.096)</td>
</tr>
<tr>
<td>Transactional Sex*** (Past 12 Months)</td>
<td>0.400</td>
<td>(0.114, 1.402)</td>
<td>0.396</td>
<td>(0.072, 2.176)</td>
</tr>
<tr>
<td>Condomless Sex (Past 12 Months)</td>
<td>1.889</td>
<td>(1.261, 2.829)</td>
<td>2.024</td>
<td>(1.330, 3.080)</td>
</tr>
<tr>
<td>Condomless Anal Sex (Past 12 Months)</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
</tbody>
</table>

*Adjusting for race, age, and education

**Did not converge

***Gave or received sex in exchange for money, drugs, or something needed
Table 7: Logistic Regression Analysis of Drug and Alcohol Behaviors And Concurrent Sexual Relationships Among the Total Analytic Sample (N=6943)

<table>
<thead>
<tr>
<th>Drug Use</th>
<th>Crude Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>Adjusted Odds Ratio*</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug Use</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marijuana Only</td>
<td>1.801</td>
<td>(1.468, 2.210)</td>
<td>1.837</td>
<td>(1.477, 2.285)</td>
</tr>
<tr>
<td>Any Other Drugs</td>
<td>1.596</td>
<td>(1.366, 1.865)</td>
<td>1.559</td>
<td>(1.328, 1.830)</td>
</tr>
<tr>
<td>Injects Drugs</td>
<td>0.702</td>
<td>(0.471, 1.048)</td>
<td>0.844</td>
<td>(0.549, 1.297)</td>
</tr>
<tr>
<td>Shares Injection Equipment</td>
<td>1.206</td>
<td>(0.568, 2.560)</td>
<td>0.788</td>
<td>(0.329, 1.884)</td>
</tr>
<tr>
<td>Binge Drinking in the 30 Days Prior to Interview</td>
<td>1.423</td>
<td>(1.212, 1.671)</td>
<td>1.481</td>
<td>(1.255, 1.748)</td>
</tr>
<tr>
<td>Sex while under the influence of drugs or alcohol (Past 12 Months)</td>
<td>1.160</td>
<td>(0.937, 1.435)</td>
<td>1.371</td>
<td>(1.088, 1.727)</td>
</tr>
</tbody>
</table>

*Adjusting for gender, race, age, and education
<table>
<thead>
<tr>
<th>Drug Use</th>
<th>Crude Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>Adjusted Odds Ratio*</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marijuana Only</td>
<td>1.266</td>
<td>0.980, 1.637</td>
<td>1.631</td>
<td>1.243, 2.141</td>
</tr>
<tr>
<td>Any Other Drugs</td>
<td>1.446</td>
<td>1.152, 1.816</td>
<td>1.407</td>
<td>1.115, 1.775</td>
</tr>
<tr>
<td>Injects Drugs</td>
<td>0.609</td>
<td>0.248, 1.497</td>
<td>0.542</td>
<td>0.215, 1.369</td>
</tr>
<tr>
<td>Shares Injection Equipment</td>
<td>0.750</td>
<td>0.118, 4.760</td>
<td>0.461</td>
<td>0.049, 4.368</td>
</tr>
<tr>
<td>Binge Drinking in the 30 Days Prior to Interview</td>
<td>1.292</td>
<td>1.032, 1.617</td>
<td>1.416</td>
<td>1.127, 1.780</td>
</tr>
<tr>
<td>Sex while under the influence of drugs or alcohol (Past 12 Months)</td>
<td>0.767</td>
<td>0.564, 1.043</td>
<td>1.039</td>
<td>0.748, 1.443</td>
</tr>
</tbody>
</table>

*Adjusting for gender, race, and education
Table 9: Logistic Regression Analysis of Drug and Alcohol Behaviors And Concurrent Sexual Relationships Among Those ≥30 Years (N=4119)

<table>
<thead>
<tr>
<th>Drug Use</th>
<th>Crude Odds Ratio</th>
<th>95% Confidence Interval</th>
<th>Adjusted Odds Ratio*</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug Use</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marijuana Only</td>
<td>2.236</td>
<td>1.581, 3.164</td>
<td>2.664</td>
<td>1.862, 3.811</td>
</tr>
<tr>
<td>Any Other Drugs</td>
<td>1.780</td>
<td>1.433, 2.213</td>
<td>1.775</td>
<td>1.426, 2.209</td>
</tr>
<tr>
<td>Injects Drugs</td>
<td>0.874</td>
<td>0.552, 1.384</td>
<td>0.902</td>
<td>0.562, 1.446</td>
</tr>
<tr>
<td>Shares Injection Equipment</td>
<td>1.343</td>
<td>0.585, 3.085</td>
<td>1.017</td>
<td>0.411, 2.517</td>
</tr>
<tr>
<td>Binge Drinking in the 30 Days Prior to Interview</td>
<td>1.526</td>
<td>1.210, 1.925</td>
<td>1.619</td>
<td>1.279, 2.051</td>
</tr>
<tr>
<td>Sex while under the influence of drugs or alcohol (Past 12 Months)</td>
<td>1.658</td>
<td>1.233, 2.228</td>
<td>2.038</td>
<td>1.480, 2.808</td>
</tr>
</tbody>
</table>

*Adjusting for gender, race, and education
11. Appendix of Figures

Figure 1: Visual Depiction of the Different Types of Two Partner Concurrency By Warren et. al (103)
Figure 2: Visual Depiction of the Different Types of Two Partner Concurrency and Sequential Monogamous Relationships By Delva et. al (54)
Figure 3: Natural History of HIV by Fauci et. al (55)
Figure 4: Study Flowchart

- 16345 Newly diagnosed patients eligible for a partner services interview
  - 13697 Patients interviewed for partner services (83.80%)
    - 6943 Patients named partners (50.70%)
      - 1027 Patients engaged in concurrent sexual relationships (14.79%)
    - 6754 Patients did not name partners (49.30%)
      - 5916 Patients did not engage in concurrent sexual relationships (85.21%)
  - 2648 Patients not interviewed for partner services (16.20%)
Figure 5: Percentage of Interviewed Index Patients Who Named Partners, New York City 2007-2017
Figure 6: Percentage of Interviewed Index Patients Who Self-Reported Anonymous Sexual Partners, New York City 2007-2017
Figure 7: Percentage of Interviewed Index Patients Who named Sexual Partners Who Self-Reported Concurrent Sexual Partnerships Among Those Who Named Partners, New York City 2007-2017
12. References


66. Recommendations for partner services programs for HIV infection, syphilis, gonorrhea, and chlamydial infection. MMWR Recomm Rep 2008;57(Rr-9):1-83; quiz CE1-4.